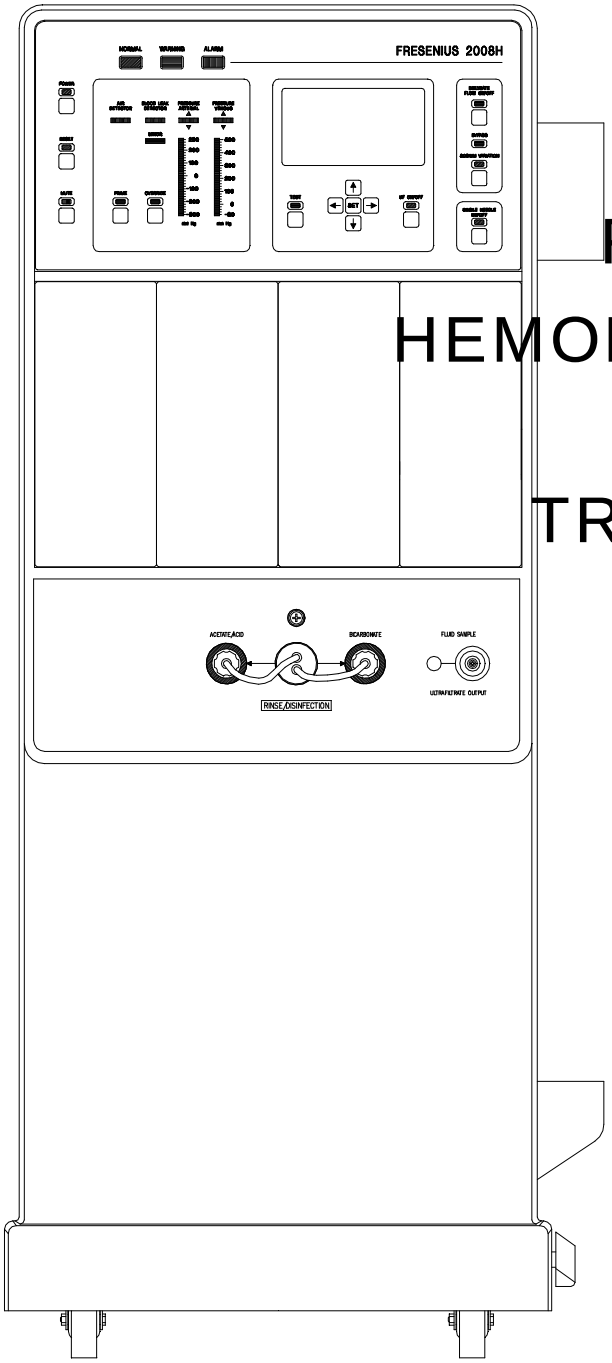


# FRESENIUS 2008H HEMODIALYSIS SYSTEM

# TROUBLESHOOTING GUIDE

Part Number 507082 Rev. B

# FRESENIUS USA, INC.

2637 Shadelands Drive, Walnut Creek, CA 94598

**800-227-2572 or 925-295-0200**

**TECHNICAL SUPPORT FOR HEMODIALYSIS SYSTEMS**

**Press 5 when the automated system answers.**

## AUTOMATED PHONE SYSTEM MENU

| Press | To Reach |
|---|---|
| 1 | An individual 4-digit extension |
| 5 | Technical Support |
| 6 | Spare Parts Ordering |
| 0 | Operator |

## USEFUL EXTENSION AND FAX NUMBERS

**Technical Support**
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**Technical Training**
Receptionist X7264 FAX 925-988-1969

**Spare Parts**
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REGIONAL EQUIPMENT SPECIALIST: _____

# FRESENIUS 2008H
# HEMODIALYSIS SYSTEM

# TROUBLESHOOTING
# GUIDE

**Part Number 507082 Rev B**

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# PREFACE

This troubleshooting guide has been developed with the help of many customers and Fresenius personnel. It is a combination of known techniques and excellent feedback from people that actually work with the equipment.

The intent of the 2008H Troubleshooting Guide is to provide you with an aid in the diagnosis of common problems. Since this document is only a guide and may not provide the most up-to-date solutions for every conceivable problem, we recommend contacting our Technical Services Support line should additional assistance be required.

**WARNING: Before using this guide you must read pages 1 through 4 which outline Using the Troubleshooting Guide, Order of Troubleshooting, Initial Checks, Safety Checks and Equipment Needed. Never troubleshoot with a patient connected to the machine. If possible, remove the machine from the treatment area when it is being serviced. Always tag the machine to ensure it is not accidentally returned to service before the service work is completed.**

**Always fully test a machine (in accordance to the Technicians Manual P/N 490004 or Operators Manual P/N 490005) when maintenance and/or repairs have been completed. This is to include confirmation of conductivity, pH and Temperature with a calibrated device.**

Should additional technical assistance be needed, technical support is provided 24 hours a day, seven days a week at our toll free number (800) 227-2572.

# USING THE TROUBLESHOOTING GUIDE

1. The equipment technician should have knowledge of clinical Hemodialysis and operational theory of the Fresenius system. A minimum of Level I training is necessary! Incorrect troubleshooting can result in injury or death to the troubleshooter and patient.

2. The equipment technician should have knowledge of the test equipment, especially the multimeter. Refer to the meter's operational manual as necessary.

3. The troubleshooting procedures are written in 'flow chart' style that systematically eliminates possible areas of failure. Read each procedure carefully before moving on. You will be prompted to the next procedure or to possible solutions. Pay careful attention to **CAUTIONS** and **NOTES**.

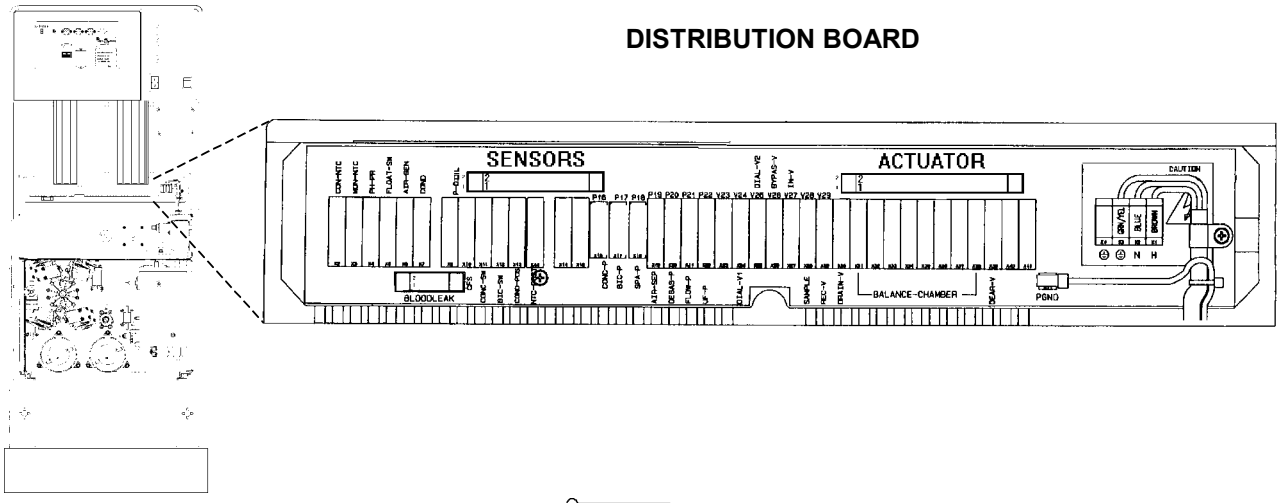
4. Many of the troubleshooting procedures are performed at the DISTRIBUTION BOARD.

   a) Inside the distribution board are several numerically identified 'male' connector positions. Male pins are arranged vertically and are numbered 1 through 5 (from top to bottom).

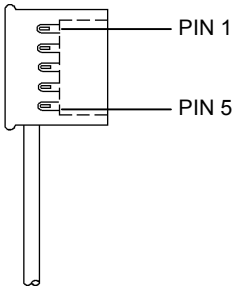
   b) Each hydraulic component has a 5-pin female connector dedicated to numeric distribution board positions as specified in the HYDRAULIC FLOW DIAGRAM. For example, flow pump #21 plugs into position [P21, FLOW-P]. Valve 43 plugs into position [V43], etc. Except for the heater, acid pump, and bicarb pump, you can plug and unplug connectors into the distribution board with the power on.

   **NOTE:** There are several unused positions including; x4 [PH-PR] (pH probe, optional), x13 [COND-POS] (on-line clearance, optional), x44 [NTC-POS] (on-line clearance, optional), V14, V15, x19 [AIR-SEP], V23 and x40 [V42]. Be CAREFUL not to accidentally plug a connector into one of these.

**DISTRIBUTION BOARD**




**FEMALE CONNECTOR**




5. If unsuccessful please call Technical Services at 1-800- 227- 2572.

# THE 'ORDER' OF TROUBLESHOOTING

Troubleshoot in the following order:

1. No Water
2. Flow Errors
3. Temperature
4. Conductivity
5. TMP
6. Blood Leak
7. Pressure Holding Test Failures

**NOTE:** Before beginning we recommend that you perform INITIAL CHECKS (page 3). This is especially important if someone has been working on the machine before you!

1. NO WATER (debug screen 5, !WATER = "1" either constantly or intermittently). Without water hydraulic operation is not possible.

2. FLOW ERRORS (debug screen 5, FLWERR = "1" either constantly or intermittently), will effect Temperature, Conductivity, TMP and Blood Leak. If a FLOW ERROR is present troubleshoot it before being concerned with any other alarms.

3. FLOW ERRORS turn the heater off and result in TEMPERATURE problems. Before troubleshooting any TEMPERATURE problem assure that the machine is free of flow errors (debug screen 5, FLWERR = "0" constantly).

4. CONDUCTIVITY is temperature compensated. Without stable temperature CONDUCTIVITY will not be stable. Before troubleshooting CONDUCTIVITY problems, assure that TEMPERATURE is normal and remaining constant from the main dialysis screen.

5. Before troubleshooting TMP problems assure that there are no flow errors present (debug screen 5, FLWERR = "0" constantly). Assure also that TEMPERATURE and CONDUCTIVITY are normal and remaining constant from the main dialysis screen.

6. Before troubleshooting PRESSURE HOLDING TEST FAILURES assure that there are no flow errors present (debug screen 5, FLWERR = "0" constantly). Assure also that TEMPERATURE and CONDUCTIVITY are normal and remaining constant from the main dialysis screen.

7. Before troubleshooting BLOOD LEAK problems assure that there are no flow errors present (debug screen 5, FLWERR = "0" constantly). Assure also that TEMPERATURE and CONDUCTIVITY are normal and remaining constant from the main dialysis screen.

**FUNCTIONAL BOARD SOFTWARE DISCLAIMER**
Functional board software may effect the TROUBLESHOOTING GUIDE. With the exception of CONDUCTIVITY PROBLEMS this guide is compatible with functional software up to 8.02

## INITIAL CHECKS

1. Turn the power **OFF** and slide the card cage forward. Check that all five boards are pushed down into the motherboard and are 'locked' in.

2. Check that the sensor and actuator cables are plugged tightly into *both ends. Check also for bare wires or other damage along their entire length.

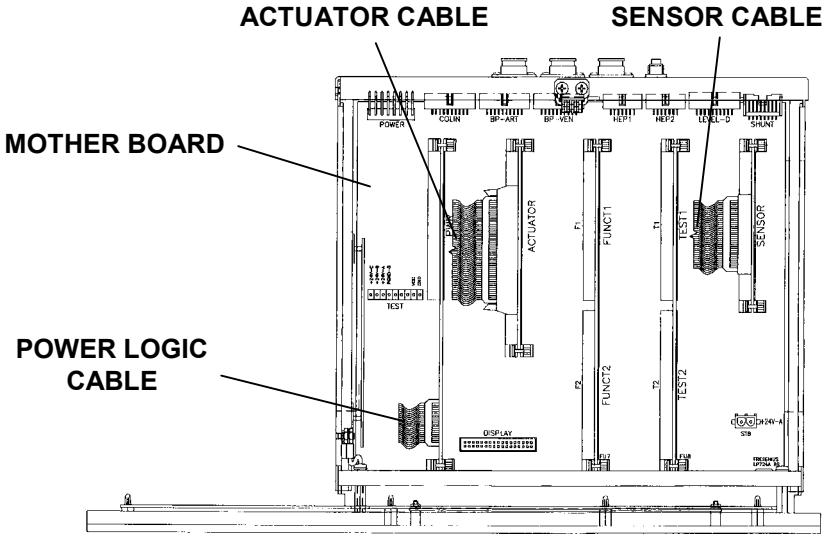
* Both cables run into the distribution board and terminate at the SENSORS and ACTUATOR connectors respectively (see DISTRIBUTION BOARD diagram below).

3. Check that the power logic board cable is plugged tightly into the power logic board.

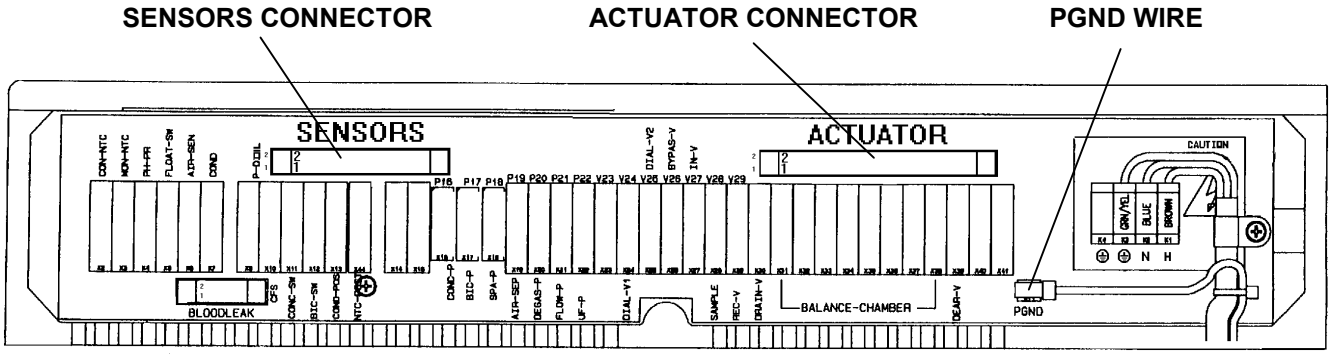
4. Check that the PGND (power ground) wire is plugged into the distribution board (see DISTRIBUTION BOARD diagram below).

5. Close the card cage**. IMPORTANT NOTE**! Do **NOT** troubleshoot with the card cage open! Turn the machine ON and return to the operating mode (DIALYSIS, RINSE, etc) where the problem is occurring.

6. Allow 10 minutes for stabilization.




**CARD CAGE, TOP VIEW**




**DISTRIBUTION BOARD**

## SAFETY CHECKS

Before placing the machine back into service:

1. Remove all test equipment (jumpers, 'dummy' connectors, etc) from the distribution board and make sure that all hydraulic components are plugged in.

2. If you have been troubleshooting TEMPERATURE problems turn the heater breaker switch off and assure that the TEMP display falls to 33°C and that the bypass condition exists.

3. If you have been troubleshooting CONDUCTIVITY problems drop the acid and bicarb lines into water and assure that the COND display falls to 10.0 and that the bypass condition exists.

4. Check that AUDIO ALARMS are working properly.

5. Perform alarm and pressure holding tests.

## EQUIPMENT NEEDED

- Fresenius gauge kit (part # 150034)

- Fresenius test (temperature) 'dummy connectors' (part # 190060)

- Graduated cylinder (1000 ml)

- Buret 0 - 25cc (part # 290104)

- 60 ml syringe

- Flashlight

- Jumper wire

- Independently calibrated temperature, conductivity, and pressure meters

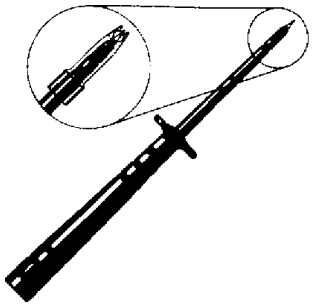
- Voltmeter (recommended Fluke "70" series)

- Clip-on meter leads (recommended Fluke TL24 Flexible test leads with AC80 pin grabbers)

* Non-standard meter probes (recommended Fluke TP80 probes)

* Non-standard meter probes assure safe voltage measurement in 'tight' areas when shorting other pins or connectors is a concern. Fluke TP80 meter probes include a slip-on cap that fits over the lead to 'isolate' the measuring point and prevent shorting.

**FLUKE TP80 METER PROBES (WITH SLIP ON CAP)**



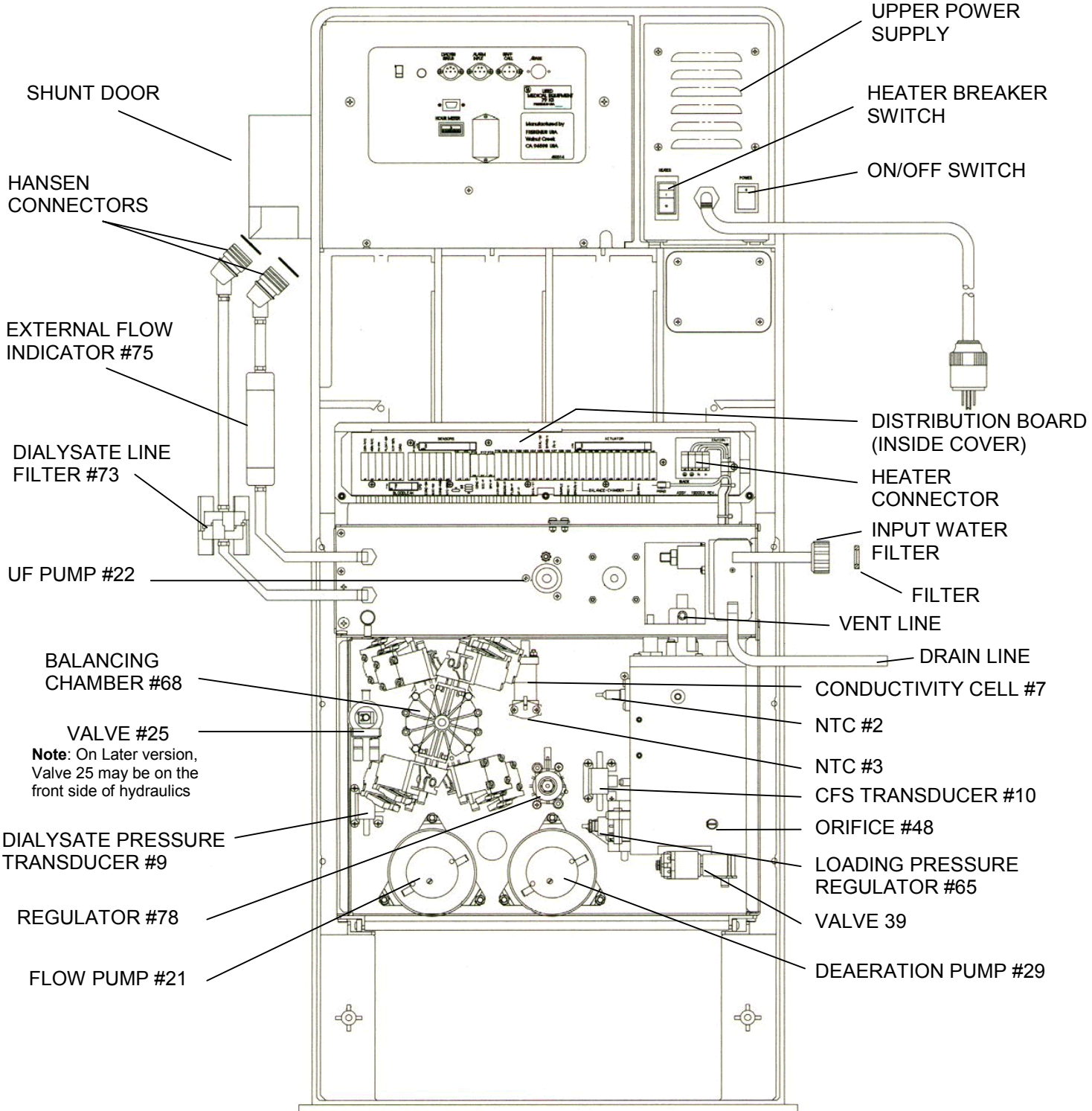



**DIAGRAM A REAR VIEW**

# SECTION 1 - FLOW ERRORS IN DIALYZE MODE

## F- 1.0.0 CHECK LOADING PRESSURE

a) Assure that the vent tube is not 'pinched' (see diagram A, page 5) .

b) Insert a *loading pressure gauge **TIGHTLY** into the ACETATE/ACID port. Peak pressure?

1) 0 to 10 psi — Call up debug screen 5. If !WATER = "1" proceed to NO WATER (page 23) otherwise proceed to F- 2.0.0

2) 17 to 25 psi — Allow two minutes (if necessary) for the symptoms to appear. See F- 3.0.0

3) Greater than 25 psi — Attempt to calibrate loading pressure to +19 psi peak per CALIBRATION PROCEDURES, section 2.13. If not successful a bad loading pressure regulator #65 is indicated (see diagram A, page 5).

* If the gauge does not read 0 psi at atmosphere compensate for this during loading pressure checks.

## F- 2.0.0 CHECK FOR A RUNNING DEAERATION PUMP

Make sure that flow is on (FLOW ON/OFF LED is off). Depending upon the pump:

1. Motors with brushes The deaeration pump's motor shaft can be accessed from the front side of the machine (see FRONT VIEW diagram below). If the shaft is *rotating the pump is running. Is the deaeration pump running?

   Yes — See F- 14.0.0 (page 12).

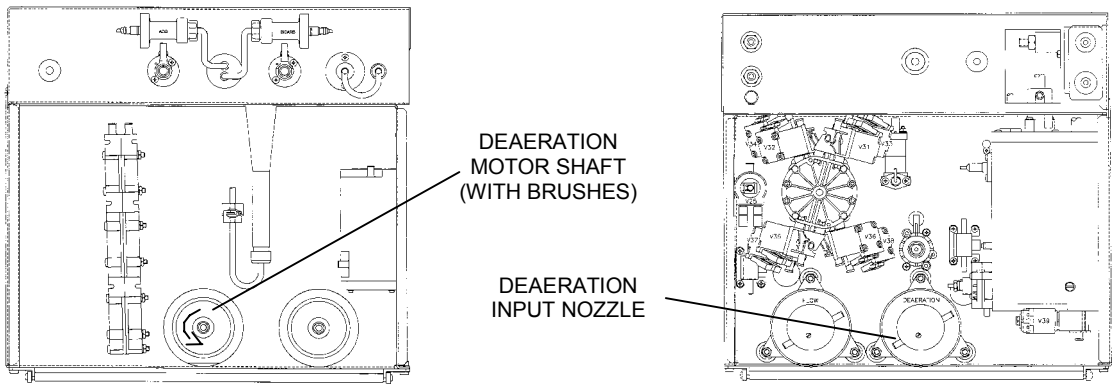
   No — See F- 18.0.0 (page 16) to check the **DEAERATION PUMP**.

* Rotation is CCW (from the front of the machine). If rotating CW the motor is running backwards

2. Motors without brushes Remove the CLEAR tubing from the deaeration pump's input nozzle (see REAR VIEW diagram below). If the pump is running you will hear 'gurgling'. Is the deaeration pump running?

   Yes — See F- 14.0.0 (page 12).

   No — See F- 18.0.0 (page 16) to check the **DEAERATION PUMP**.




**FRONT VIEW** **REAR VIEW**

## F- 3.0.0 CHECK DEBUG ERRORS

**CAUTION** Do NOT attempt to reset other alarms during this check!

Call up debug screen 5 and watch !WATER and FLWERR for two minutes. Proceed accordingly:

1) !WATER and FLWERR = "0" constantly. See F- 3.0.1

2) !WATER = "1" constantly or intermittently. See NO WATER (page 23).

3) FLWERR = "1" constantly or intermittently. See F- 4.0.0

## F- 3.0.1 FLOW ERROR NOT PRESENT

- If COND is CONSTANTLY high. Watch FLWERR for several minutes. If it goes to "1" see F- 4.0.0
- If COND is drifting from normal to high. Wait until the BYPASS LED is off and watch FLWERR for 30 seconds. If it goes to "1" see F- 6.0.0.
- If conductivity remains normal. If FLWERR remains " 0" constantly a flow error is not indicated.
- If conductivity remains low and FLWERR remains "0" a flow error is NOT present.

## F- 4.0.0 CHECK FOR FILLING PROGRAM

Call up debug screen 7. Is FILACT "1" or "0"?

"1" See F- 4.0.1

"0" See F- 5.0.0

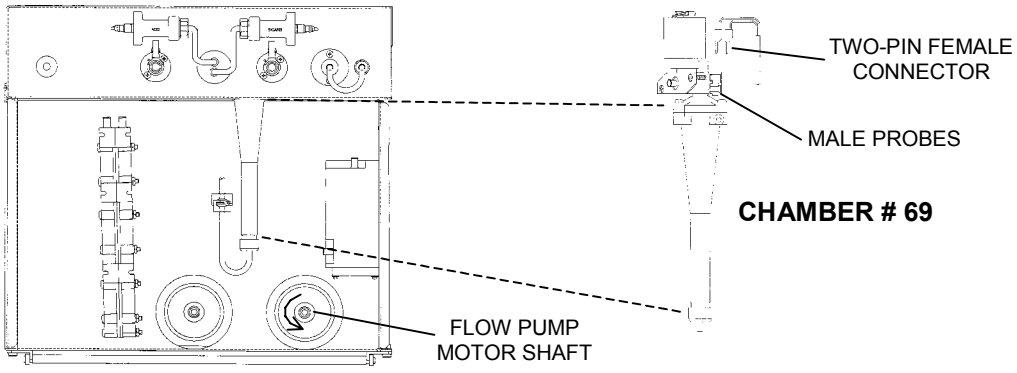
## F- 4.0.1 FILLING PROGRAM PRESENT

a) At the top of chamber #69 is a two-pin female connector that plugs onto two male probes (see diagram, below). Unplug both sides of the connector and connect the female ends together. FILACT should now = 0.

b) Return to debug screen 5 and watch for 3 minutes. Does FLWERR go to "0" and REMAIN?

Yes See F- 4.0.2.

No Plug the female connector back onto the probes and see F- 5.0.0.




**FRONT VIEW**

## F- 4.0.2 CHECK FLOW PUMP

From the front side of the machine you can see the flow pump's motor shaft (see FRONT VIEW diagram, previous page). Turn the flow off. Is the shaft rotating?

Yes Replace the actuator board.

No See F- 16.0.0 (page 14).

## F- 5.0.0 CHECK FOR A *VALVE ERROR

Proceed with this step ONLY if FILACT and !WATER are both = "0" continuously.

From DIALYZE MODE return to debug screen 5. Watch VLVERR **VERY** carefully for **two full minutes**. If a valve error is present VLVERR 'blinks' momentarily to "1" (about every 60 seconds). If a valve error is present VLVERR goes to "1" for ONLY a second. If you look away you may miss it! Does VLVERR ever 'blink' "1"?

Yes See F- 5.0.1

No See F- 6.0.0

* VALVE ERRORS indicate either high or low current in a particular 'valve circuit'.

## F- 5.0.1 LOCATING THE VALVE ERROR

Listen carefully in the area of the hydraulics (you may need to remove them from the machine). You should be able to hear a continuous, dull, 'thudding'. Proceed step-by-step and follow the given instructions.

1) From DIALYZE MODE open the shunt door. If the 'thudding' stops a **VALVE 25** is causing the error. Note this (valve 25 is the problem) and see TROUBLESHOOTING VALVE ERRORS (page 30). If the 'thudding' continues proceed to step 2.
2) Turn the flow off. If the 'thudding' stops a BALANCING CHAMBER VALVE is causing the error. Note this (balancing chamber valve is the problem) and see TROUBLESHOOTING VALVE ERRORS (page 30). If the 'thudding' continues proceed to step 3.
3) The 'thudding' continues with the shunt door open and flow off. **VALVE 30** or **26** is causing the error. Note this (valve 30 or 26 is the problem) and see TROUBLESHOOTING VALVE ERRORS (page 30). Troubleshoot **BOTH** valves.

## F- 6.0.0 CHECK FLOW ERROR 'IN BYPASS'

Open the shunt door to cause bypass. Return to debug screen 5 and watch FLWERR for **one full minute**. Does FLWERR go to "0" constantly or does it still = "1" (either constant or intermittent)?

"0" constantly  See F- 6.0.1

Still = "1"  Close the shunt door and see F- 7.0.0

## F- 6.0.1 CHECK FLOW ERROR 'OUT OF BYPASS'

a) Leave the shunt door open and return to the main DIALYSIS screen.

b) Allow TEMP and COND to become normal.

c) Close the shunt door (bypass LED should turn off) and return to debug screen 5. Wait 30 seconds. Does FLWERR = "1"?

Yes  See F- 17.0.0 (page 15).

No  A flow error is not indicated.

## F- 7.0.0 CHECK FOR A RUNNING FLOW PUMP

**CAUTION** Do NOT attempt to reset other alarms during this check!

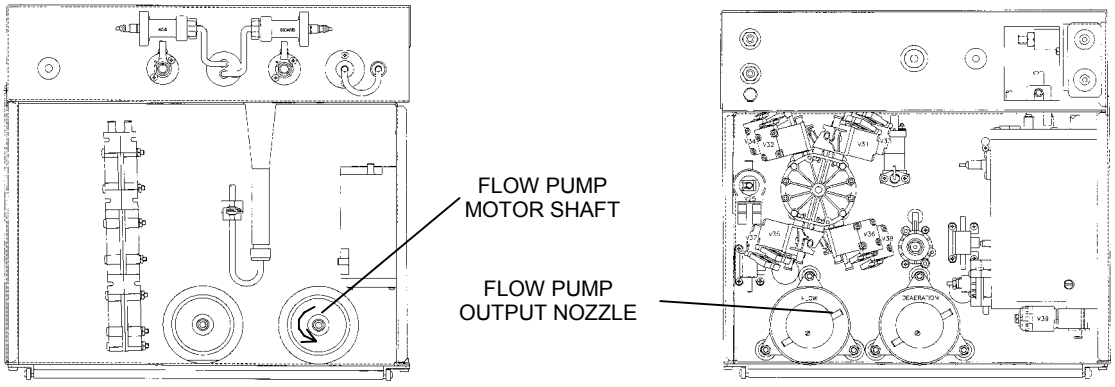
a) At this time NOTE if FLWERR = "1" constantly or intermittently for future use.

b) From the FRONT of the machine you can see the flow pump's motor shaft (see FRONT VIEW diagram below). If the shaft *rotating?

Yes  See F- 8.0.0

No  See F- 18.0.0 (page 16) to check the **FLOW PUMP**.

* Rotation is CCW (from the front of the machine). If rotating CW the motor is running backwards




**FRONT VIEW**  **REAR VIEW**

## F- 8.0.0 CHECK FLOW PUMP CONTROL

Turn the flow off and check the flow pump's motor shaft again. Still rotating?

Yes Replace the actuator board (pump driver (IC18) possibly shorted).

No a) Turn the flow on.

b) FLWERR may = "0" for a few seconds after turning flow on. Ignore this! As noted previously (step F- 7.0.0) was FLWERR = "1" constant or intermittent?

Constant See F- 10.0.0

Intermittent See F- 9.0.0

## F- 9.0.0 CHECK FOR NO WATER

Turn the flow on and call up debug screen 5 and carefully watch !WATER for **two minutes**. Does !WATER go to "1" at any time during this time interval?

Yes See NO WATER (page 23).

No See F- 9.0.1

## F- 9.0.1 CHECK FLOW PUMP PRESSURE

a) Tee a pressure gauge between the flow pump's output nozzle and the WHITE tubing (see REAR VIEW diagram, previous page).

b) Turn the flow on at a 500 flow rate. Does pressure peak to 14 psi or greater?

Yes See F- 13.0.0 (page 12)

No Three possibilities: 1) Bad actuator board; 2) Bad flow pump head; 3) Bad flow pump motor.

## F- 10.0.0 CHECK DRAIN FLOW

a) Having a bucket handy and go to end of the drain line. Hold it UP, at a 45 degree angle, over the bucket. CAUTION! Holding the drain line lower than 45 degrees makes this test invalid!

b) Watch for 20 seconds. Flow may be intermittent and this is normal. Is there any flow through the drain line?

Yes See F- 10.1.0

No See F- 11.0.0

## F- 10.1.0 DETERMINING DRAIN FLOW

Normal Fresenius drain output 'pulses' in 30 ml increments, stops completely, and then 'pulses' out again. Is drain flow 'pulsing' or 'continuous' (never stops)?

Pulsing — See F- 13.0.0 (next page).

Continuous — Three possibilities: 1) Partial restriction to drain (check the drain line first for restrictions); 2) Balancing chamber valve remaining open (run automated valve leak test from SERVICE/DIAGNOSTICS); 3) Leaking balancing chamber diaphragm (see TESTING FOR A LEAKING BALANCING CHAMBER DIAPHRAGM).

## F- 11.0.0 CHECK FLOW TO (DRAIN) VALVE 30

**CAUTION!** During this procedure there will be spillage. Move the hydraulics away from the cabinet to prevent spillage into the cabinet!

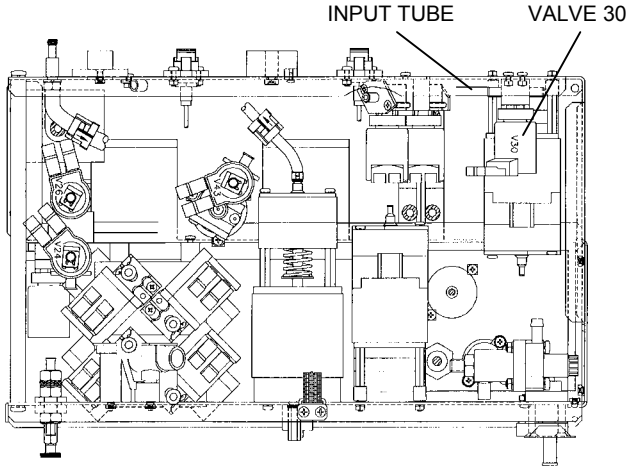
a) Turn the flow off and remove the INPUT tube from valve 30 (see TOP VIEW diagram below). Point it AWAY from the hydraulics.

b) Turn the flow on. Is there good 'pulsing' flow here?

Yes — Turn flow off and attach the tubing to valve 30. See F- 11.1.0

No — See F- 12.0.0

**TOP VIEW**




**REAR OF MACHINE**

## F- 11.1.0 CHECK VALVE 30

a) Turn the flow on.

b) Remove the drain line from the back of the machine. Is there good 'pulsing' flow here?

Yes — The drain line is restricted.

No — A problem is indicated with **VALVE 30** or the actuator board. **NOTE** this and see TROUBLESHOOTING VALVES (page 29).

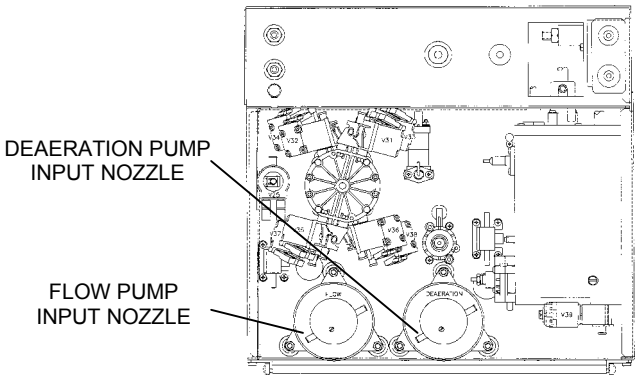
## F- 12.0.0 CHECK FLOW TO FLOW PUMP

Proceed with this step if you are VERY sure that VLVERR (debug screen 5) is always "0".

Place the machine into RINSE and remove the CLEAR tube from the flow pump's INPUT nozzle (see diagram below). Good flow here?

Yes A problem is indicated with **VALVE 26** or the actuator board. **NOTE** this and see TROUBLESHOOTING VALVES (page 29).

No Replace the actuator board. If the flow error continues there may be two bad valves (remaining closed) on the balancing chamber.




**REAR VIEW**

## F- 13.0.0 CHECK CFS SIGNAL

Making sure that flow is on call up debug screen 11 and watch ACFS (in vdc). SIX possibilities:

1) Constant flow error and ACFS remaining between 3 and 7. See F- 21.0.0 (page 20).
2) Constant flow error and ACFS remaining between 8 and 11. See F- 23.0.0 (page 22).
3) Constant flow error and ACFS remaining between 0 and 3. See F- 20.0.0 (page 18).
4) Intermittent flow error and ACFS remaining between 3 and 7. See F- 21.0.0 (page 20).
5) Intermittent HIGH FLOW error. Call up debug screen 10 and watch CFS for a couple of minutes. If CFS intermittently 'bounces' to about 10 replace the CFS transducer (#10). If the problem continues check for a bad connection at the sensor board cable on both sides (especially the distribution board side, unplug the cable and check the male pins for corrosion ). There may also be an intermittent open in the sensor cable or a problem with the sensor or actuator boards.
6) Intermittent flow error and ACFS 'bouncing' (about every 9 seconds) from between 0 and 3 to about 5. A problem is indicated with a BALANCING CHAMBER VALVE. See F- 19.0.0 (page 16).

## F- 14.0.0 LOW LOADING PRESSURE, DEAERATION PUMP RUNNING

**NOTE**: This procedure checks for water in the hydroblock and proper float functional.

a) Stop the deaeration pump by unplugging it from distribution board position P20, DEAR-P.
b) If you haven't done so remove the CLEAR (input) tube from the deaeration pump's nozzle (see REAR VIEW diagram, above). Is there flow from the tube?

Yes See F- 14.0.1

No See F- 15.0.0

## F- 14.0.1 CHECK INCOMING WATER

Allow this flow to continue for about three minutes (you may need a bucket). You should hear water entering the hydroblock in cycles as the float falls and rises. Does flow remain continuous?

Yes See F- 14.0.2

No See F- 15.0.0

## F- 14.0.2 CHECK LOADING PRESSURE REGULATOR

a) Plug the deaeration pump back into the distribution board (P20, DEAR-P) and assure that it starts running i.e. the motor shaft rotates. Allow one minute and check if loading pressure returns to normal (19 ± 1 psi). If it does there may be an intermittent problem with the float. Continue to part b otherwise.

b) Tightly clamp the solid tubing between the loading pressure regulator and the hydroblock (see diagram below). Is there a drastic increase of loading pressure?

Yes A problem is indicated with the loading pressure regulator.

No A problem is indicated with the deaeration pump head.

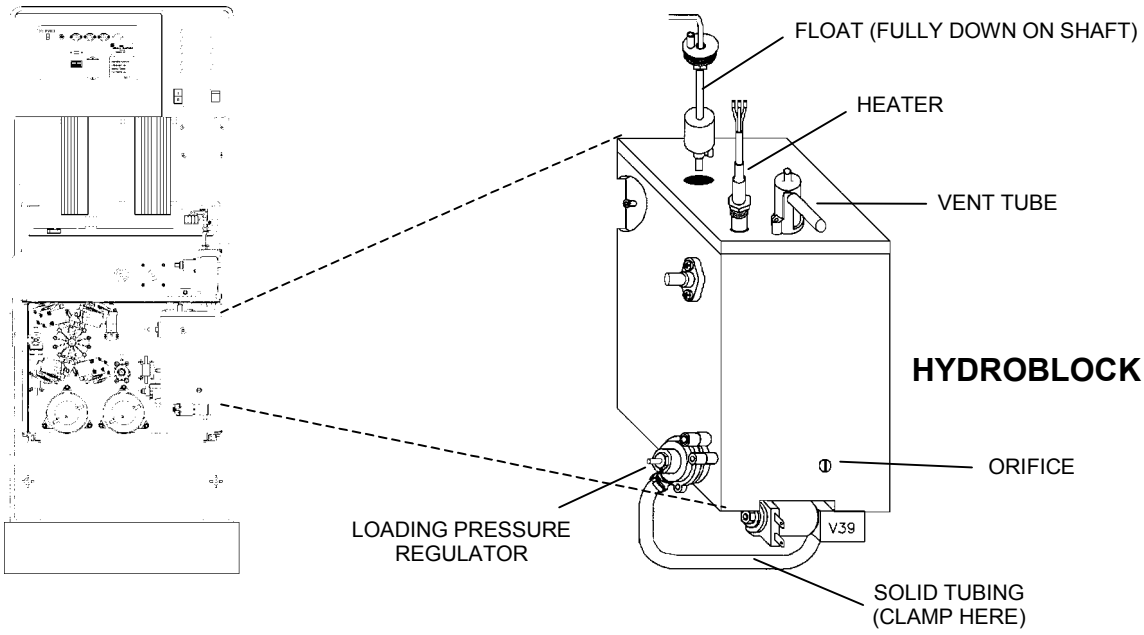
## F- 15.0.0 CHECK HYDROBLOCK

a) Clamp the vent tube and remove the orifice from the hydroblock (see diagram below). Check if it is plugged. If plugged this is the problem.

b) Re-install the orifice and **REMOVE** the clamp from the vent tube.

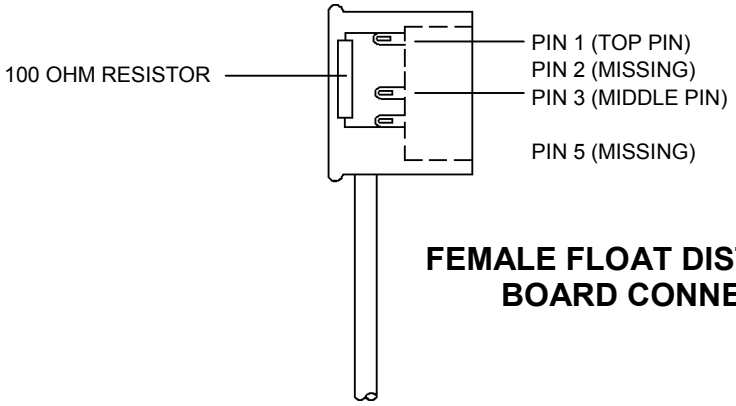
c) Turn the power off.

d) Loosen (but don't remove) the screws that mounts the float into the hydroblock (see diagram below). **CAUTION** Don't pull on the float's wiring harness or you may break it! Carefully remove the float from the hydroblock.




e) Unplug the float from distribution board position FLOAT-SW. Check inside the distribution board for bent broken or corroded male pins.

f) Very carefully open the cover on the female connector (see diagram below). Note that pins 2 and 5 are missing. Clip meter leads onto pins 1 and 3 (pin 1 = top of the 100 ohm resistor, pin 3 = middle pin). CAUTION! Be careful to clip onto the correct pins!




**FEMALE FLOAT DISTRIBUTION BOARD CONNECTOR**

g) With the float **FULLY DOWN** on the shaft you should read approximately 100Ω, **FULLY UP** an 'open' (OL). Move the float FULLY UP and DOWN twenty times while watching the transition on the meter. It should go from OL to 100Ω everytime! If the float checks out good see F- 15.0.1

## F- 15.0.1 CHECK INCOMING WATER

a) Plug the float's connector back into the distribution board (position FLOAT-SW).

b) Hold the float in its **FULLY UP** position. Turn the power on and wait until the SELECT PROGRAM screen is up.

c) Looking into the hydroblock's float cavity turn the power on. **CAUTION** Avoid overflow during this step! Move the float to its FULLY DOWN position. Is the water level rising?

Yes See F- 15.0.2

No Two possibilities: 1) *Bad sensor board cable; 2) Bad actuator board.

* The sensor cable can be checked for continuity. Note that you are checking the **FLOAT** connection and see CHECKING THE SENSOR BOARD CABLE (page 74).

## F- 15.0.2 CLEARING AN AIR LOCK

a) Connect a 60 ml syringe to the clear INPUT tubing of the deaeration pump and draw on it. You may have to pull five or six syringes full of air before water flows continuously by itself. If you are not able to make water flow continuously it may be indicative of a 'stripped' orifice.

b) Re-connect the INPUT tubing to the deaeration pump and plug the deaeration pump back into the distribution board (P20, DEAR-P). Assure that it starts running i.e. the motor shaft rotates. Allow a few minutes for loading pressure to return to normal. **NOTE**: Recurring air locks may be indicative of a bad deaeration pump head, motor or a 'stripped' orifice.

## F- 16.0.0 TROUBLESHOOTING 'FILLING PROGRAM' FLOW ERRORS

During **FILLING PROGRAMS** the dialysate pressure transducer #9 determines the presence of flow.

a) Plug the connector back onto the probes.

b) Remove the dialysate lines from the shunt door and drop them into a bucket of water on the floor.

c) **IMPORTANT** Close the shunt door.

d) Call up debug screen 9 and wait 30 seconds. Is PDIA between 4.0 and 6.0 vdc?

Yes See F- 16.0.1

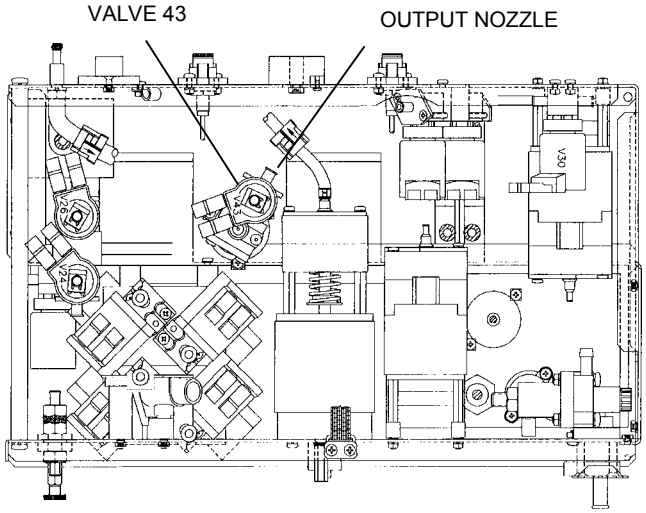
No See TM- 2.0.1, TMP PROBLEMS (page 58).

## F- 16.0.1 CHECK VALVE 43

**CAUTION**! During this procedure there will be spillage. Move the hydraulics away from the cabinet to prevent damage.

a) Place the machine into RINSE.

b) Clamp and remove the tubing from the valve 43's output nozzle (see diagram below).




**HYDRAULICS, TOP VIEW**

c) Call up debug screen 20. When V43= 1 the actuator board is sending a signal to open valve 43. This occurs every two minutes for several seconds. When V43= 1 is there flow from valve 43's nozzle?

Yes Flow errors sometimes occur if a FILLING PROGRAM is prolonged.

No A problem is indicated with **VALVE 43** or the actuator board. **NOTE** this and see CHECKING VALVES (page 28).

## F- 17.0.0 TROUBLESHOOTING FLOW ERRORS 'OUT OF BYPASS'

A problem is indicated in the 'out of bypass' circuit which includes the external dialysate filter (73), valves 24 and 25. **CAUTION!** There will be spillage during this procedure. Make sure the card cage is closed!.

a) Place the machine into RINSE.

b) Open the shunt door and remove the RED dialysate line. Is there flow from the shunt door?

Yes a) Stop RINSE by pulling the red concentrate connector from its port

b) Check the external dialysate line filter #73 (see diagram A, page 5). If the filter is clean a problem is indicated with **VALVE 25** or the actuator board. **NOTE** this and see TROUBLESHOOTING VALVES (page 29).

No A problem is indicated with **VALVE 24**, the actuator board or actuator cable. **NOTE** this and see CHECKING VALVES (page 28).

## F- 18.0.0 TROUBLESHOOTING PUMPS

Proceed ONLY with the pump of interest.

a) Make sure that flow is on and the proper flow rate is selected as directed in the table below.

b) Unplug the noted pump from the distribution board. Check, inside the distribution board, for bent, broken, or corroded male pins.

c) Measure dc voltage, inside the distribution board, between male pins 1 and 5 (top and bottom).

| PUMP | DISTRIBUTION BOARD POSITION | FLOW RATE (ml/min) | VOLTAGE RANGE | BAD |
|---|---|---|---|---|
| DEAERATION | P20, DEGAS-P | 500 | 16 vdc or greater | Replace the pump head |
| | | | Less than 16 vdc | Two Possibilities:<br>1. [1]Actuator cable<br>2. Actuator board |
| FLOW | P21, FLOW-P | 800 | 12 vdc or greater | Replace the pump head |
| | | | Less than 12 vdc | Two Possibilities:<br>1. [2]Actuator cable<br>2. Actuator board |

[1] The actuator cable can be checked for continuity. Note that you are checking **DEAERATION PUMP** connections and see CHECKING THE ACTUATOR BOARD CABLE (page 72).

[2] The actuator cable can be checked for continuity. Note that you are checking **FLOW PUMP** connections and see CHECKING THE ACTUATOR BOARD CABLE (page 72).

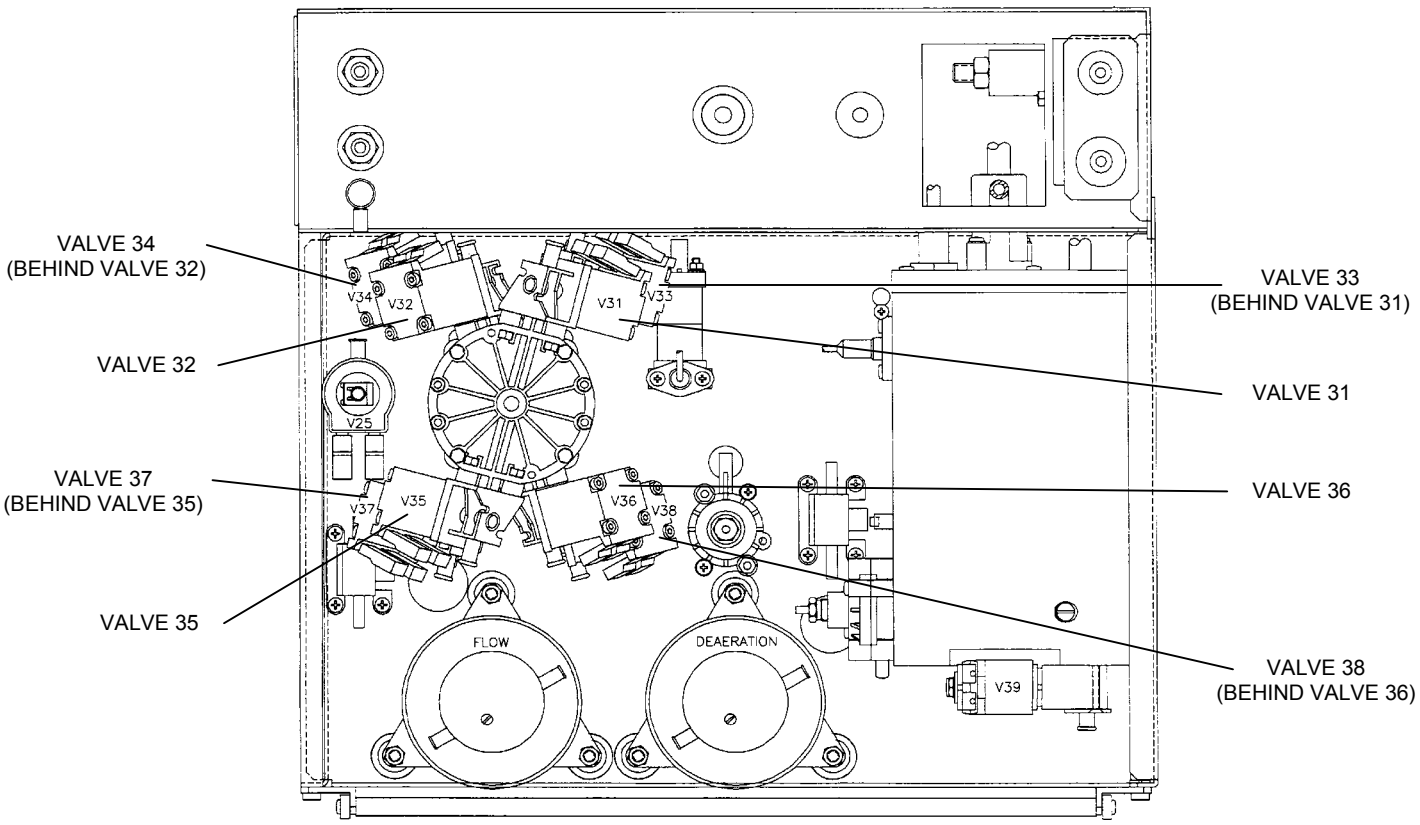
## F- 19.0.0 TROUBLESHOOTING BALANCING CHAMBER VALVES

A balancing chamber valve may be remaining open or closed at all times.

a) Check that all balancing chamber valves are plugged into the distribution board at their proper positions (V31 through V38). If ok proceed.

b) Turn the power off and swap in a good actuator board.

c) Put the machine back into dialyze mode. Call up debug screen 5 and watch FLWERR for **several** minutes. If the flow error is still intermittent see F- 19.0.1.




**HYDRAULICS, REAR VIEW**

## F- 19.0.1 CHECKING VALVES 36 AND 38

**NOTE**: The previous actuator board is good.

a) Turn the machine off and then back on. Wait until the SELECT PROGRAM screen is up.

b) **IMPORTANT!** Do **NOT** place the machine into dialyze mode. From SELECT PROGRAM is there flow to the drain?

Yes — Using a metal clamp tightly clamp the solid tubing at balancing chamber valve 36 (see diagram, above). If flow stops replace valve 36. If not replace valve 38.

No — See F- 19.0.2

## F- 19.0.2 CHECKING VALVE 32

Unplug valves 32 and 36 from the distribution board (V32 and V36). Plug 36 into 32's position and visa versa. If there is flow to the drain replace valve 32. If not carefully plug both valves back into their proper distribution positions and see F-19.0.3

## F- 19.0.3 CHECKING VALVE 34

Unplug valves 34 and 38 from the distribution board (V34 and V38). Plug 34 into 38's position and visa versa. If there is flow to the drain replace valve 34. If not carefully plug both valves back into their proper distribution board positions and see F-19.0.4.

## F- 19.0.4 CHECKING FOR CLOSED BALANCING CHAMBER VALVES

Place the machine into dialyze mode and TIGHTLY clamp the clear tubing at valve 31 (see diagram, above). From debug screen 5, does FLWERR now go constant "1"?

Yes Referencing the flow diagram, the problem is a valve in the right-side balancing chamber. See F- 19.0.5

No FLWERR remains intermittent. Referencing the flow diagram, the problem is a valve in the left-side balancing chamber. See F- 19.0.6

## F- 19.0.5 'RIGHT-SIDE' VALVE BAD

a) Turn the power off and unplug valves 37 and 34 from the distribution board (positions V37 and V34).

b) Plug valve 37 into 34's position (V34), leaving valve 34 unplugged.

c) **IMPORTANT!** Do **NOT** place the machine into dialyze mode. From SELECT PROGRAM check drain flow. Is there strong flow to the drain?

Yes Note that either valve 38 or 34 is not opening and see F- 19.0.7

No Note that either valve 37 or 33 is not opening and see F- 19.0.7

## F- 19.0.6 'LEFT-SIDE' VALVE BAD

a) Turn the power off and unplug valves 35 and 32 from the distribution board (positions V35 and V32).

b) Plug valve 35 valve 32's position (V32), leaving valve 32 unplugged.

c) **IMPORTANT!** Do **NOT** place the machine into dialyze mode. From SELECT PROGRAM check drain flow. Is there strong flow to the drain?

Yes Note that either valve 32 or 36 is not opening and see F- 19.0.7

No Note that either valve 35 or 31 is not opening and see F- 19.0.7

## F- 19.0.7 CHECK FOR A 'MECHANICALLY STICKING' VALVE

a) Check the noted valve's distribution board connector position for bent, broken or corroded male pins.

b) Carefully plug all valves back into their proper distribution board position.

c) Place the machine into dialyze mode and call up debug screen 7. FILACT **MUST** = "0" to continue.

d) If the valve bodies are clear check the valve plungers for movement and replace the one that is not moving. If the valve bodies are solid, swap one of the valves and check for flow errors.

## F- 20.0.0 ACFS BETWEEN 0 AND 3

The CFS transducer is acting like a 'short'. Turn flow off. Does ACFS go to between 3 and 7?

Yes **IMPORTANT** turn flow on and return to F- 7.0.0 (the CFS transducer is good).

No See F- 20.0.1

### F- 20.0.1 CHECK CFS CIRCUIT

Unplug the CFS transducer from the distribution board (position CFS). Check, for bent, broken or corroded male pins. Is ACFS between 8 and 11?

Yes See F- 20.0.2

No ACFS remains between 0 and 3. See F- 20.0.7

### F- 20.0.2 CHECK SENSOR BOARD CFS VALUE

Leave the transducer unplugged and call up debug screen 10. Is CFS between 8 and 11?

Yes See F- 20.0.3

No Replace the sensor board.

### F- 20.0.3 CHECK FOR A LEAKING BALANCING CHAMBER VALVE

a) Plug the CFS transducer back into the distribution board and assure that ACFS returns to between 0 and 3.

b) Turn the flow on and push SET to return to the DIALYSIS screen. Is TMP pegged at +60?

Yes See F- 20.0.4

No Replace the CFS transducer (see diagram, next page).

### F- 20.0.4 CHECK FOR A LEAKING BALANCING CHAMBER VALVE

a) Push and release the RESET button on the front panel. The message "ADJUST TMP?" appears.

b) Immediately push and HOLD the RESET button. After the "ADJUSTING TMP" message is gone does TMP return to +60 or remain relatively stable?

+60 See F- 20.0.5

Stable Replace the CFS transducer (see diagram, next page).

### F- 20.0.5 CHECK FOR A LEAKING BALANCING CHAMBER VALVE

a) Place the machine into SERVICE/DIAGNOSTICS.

b) Select and enter #11 VALVE LEAK TEST. Wait until the "READY" message appears.

c) Push SET **TWICE** to start the test. Is a leaking valve indicated?

Yes Note the leaking valve and see F- 20.0.6

No Replace the CFS transducer (see diagram, next page).

## F- 20.0.6 CHECK FOR SHORTED VALVE DRIVER

a) Unplug the **NOTED** valve from the distribution board.

b) Measure dc voltage, inside the distribution board, between male pins 1 and 5 (top and bottom). One volt or greater?

Yes Replace the actuator board.

No Replace the indicated leaking valve.

## F- 20.0.7 TROUBLESHOOTING THE CFS CIRCUIT

Leave the transducer unplugged for now and call up debug screen 10. Is CFS also between 0 and 3?

Yes See F- 22.0.0

No Between 8 and 11. Replace the actuator board.

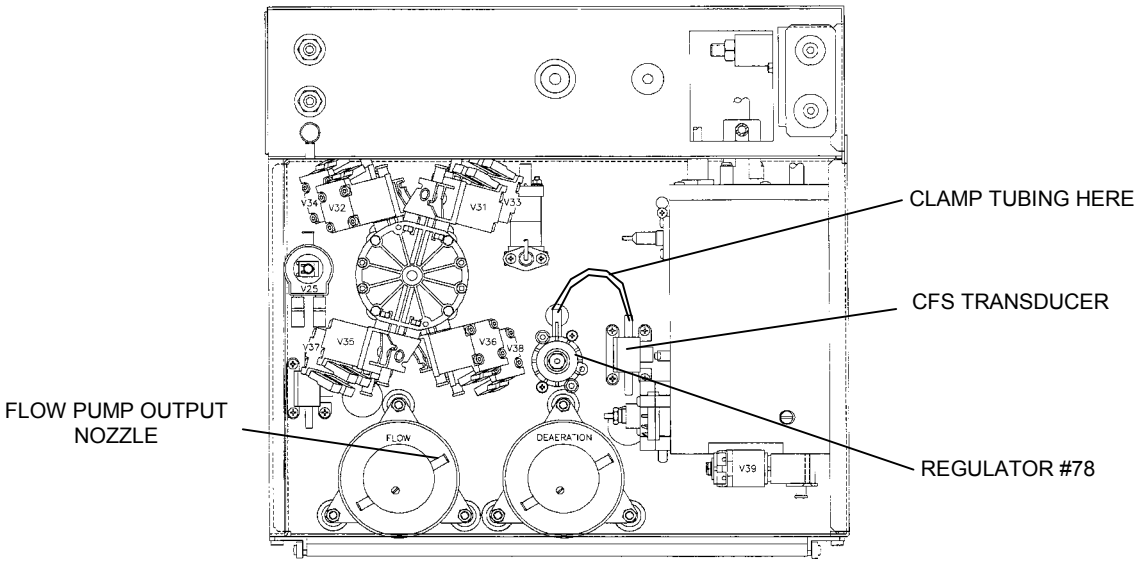
## F- 21.0.0 ACFS BETWEEN 3 AND 7

The CFS transducer is not switching the balancing chamber valves properly.

Clamp the solid tubing between the output of the CFS transducer and regulator #78 (see diagram below). Does ACFS go to below 2 now?

Yes Replace regulator #78 (see diagram below).

No See F- 21.0.1




**REAR VIEW**

## F- 21.0.1 CHECK FLOW PUMP PRESSURE

1) Remove the clamp.

2) Turn the flow off and tee a psi gauge between the flow pump's output nozzle and the SOLID tubing (see diagram on previous page).

3) Turn the flow on at a 500 flow rate. Does pressure peak to 14 psi or greater?

   Yes See F- 21.0.2

   No Three possibilities: 1) Bad actuator board; 2) Bad flow pump head; 3) Bad flow pump motor.

## F- 21.0.2 CHECK CFS CIRCUIT

Unplug the CFS transducer from the distribution board (position CFS) and check for bent, broken or corroded male pins. Is ACFS between 8 and 11?

   Yes See F- 21.0.3

   No ACFS remains between 3 and 7. See F- 21.0.4

## F- 21.0.3 CHECK SENSOR BOARD CFS VALUE

Leave the CFS transducer unplugged and call up debug screen 10. Is CFS between 8 and 11?

   Yes a) Plug the CFS transducer back into distribution board (position x10, CFS).

   b) If CFS remains between 3 and 7 and the flow error is still present there are four possibilities: 1) Bad actuator board; 2) Bad flow pump head; 3) Bad flow pump motor motor; Bad CFS transducer (see diagram, previous page).

   No Replace the actuator board.

## F- 21.0.4 TROUBLESHOOTING THE CFS CIRCUIT

Leave the transducer unplugged for now and call up debug screen 10. Is CFS also between 3 and 7?

   Yes See F- 22.0.0

   No Between 8 and 11. Replace the actuator board.

## F- 22.0.0 CHECK SENSOR BOARD CABLE

a) Turn the power off and unplug the 34-pin ribbon cable from the top of the sensor board [card cage, smallest board, right hand side].

b) Turn the power on.

c) Push the SET button ONCE to enter the VERIFY CONCENTRATE screen

d) Call up debug screen 11. Is CFS between 8 and 11 now?

   Yes Unplug both sides of the 34-pin ribbon cable from the sensor and distribution board's SENSORS connector. Look for bent male pins inside each connector. If ok replace the 34-pin ribbon cable.

   No Three possibilities: 1) Bad sensor board; 2) Bad actuator board; 3) Bad functional board;

## F- 23.0.0 ACFS BETWEEN 8 AND 11

An CFS transducer is acting 'open'. There are several possibilities that may cause this symptom.

Call up debug screen 10. Is CFS also reading between 8 and 11?

Yes See F- 23.0.1

No Replace the actuator board.

## F- 23.0.1 CHECK CFS TRANSDUCER FOR AN 'OPEN'

a) Unplug the CFS transducer from distribution board position CFS. Check, inside the distribution board, for bent, broken or corroded male pins.

b) Plug the 34 degree Fresenius temperature 'dummy connector' into the CFS's distribution board position (CFS). Does CFS go to between 0 and 2?

Yes [1]Replace the CFS transducer (see diagram, page 20).

No Two possibilities: 1) [2]Bad sensor board cable; 2) Bad sensor board.

[1] Before replacing the transducer, check if there is a pig tail extension in the cable between the transducer and the distribution board. If present make sure it is plugged in properly using the 'key' on the pig tail connector. The pig tail is not present in all cases.

[2] The sensor cable can be checked for continuity. Note that you are checking **CFS TRANSDUCER** connections and see CHECKING THE SENSOR BOARD CABLE (page 74) .

# SECTION 2 - NO WATER

## NW- 1.0.0 CHECK INCOMING WATER SYSTEM

a) Assure that the water is on and that the vent tube is not 'pinched' (see diagram A, page 5).

b) Turn the water off and check the input water filter for restrictions (see diagram A, page 5).

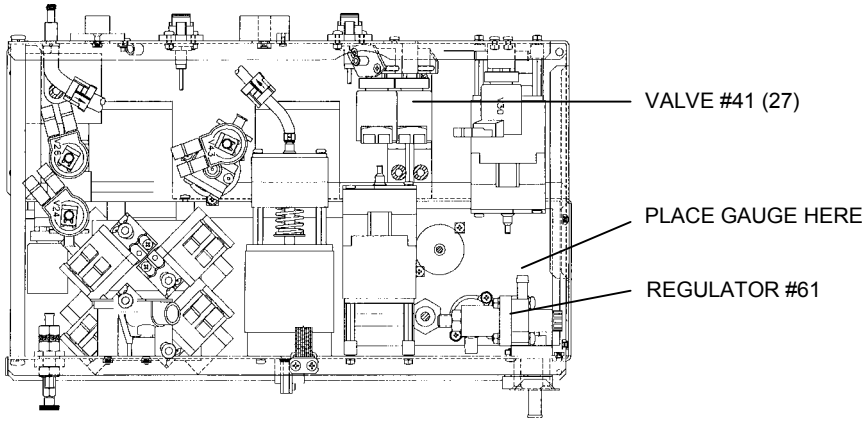
c) Before hooking the incoming water line back up assure that there is adequate incoming water flow.

d) Tee a pressure gauge at the output of side of pressure regulator #61 (see TOP VIEW diagram below) and hook the incoming water line to the machine.

e) Turn the water on and assure that the machine is in **DIALYZE** mode. Pressure 19 ± 1 psi at its peak?

Yes See NW- 2.0.0

No Attempt calibration (see section 3.1, CALIBRATION MANUAL). If calibration is not possible a bad pressure regulator #61 is indicated.




**HYDRAULICS, TOP VIEW**

## NW- 2.0.0 CHECK INCOMING WATER

a) Unplug the float connector from the distribution board (position x5, FLOAT-SW). Check, inside the distribution board, for bent, broken or corroded male pins.

b) Place a jumper wire, inside the distribution board, between male pins 1 and 3 (top and middle pins). The jumper simulates the float switch being 'closed' and should open valve #41 (27). After no more than one minute is there overflow from the vent tube?

Yes See NW- 3.0.0

No Leave the jumper in place. A problem is indicated with **VALVE 41 (27),** the actuator board or the actuator cable. NOTE this and see CHECKING VALVES (page 28).

## NW- 3.0.0 CHECK FOR INTERMITTENT BAD FLOAT SWITCH

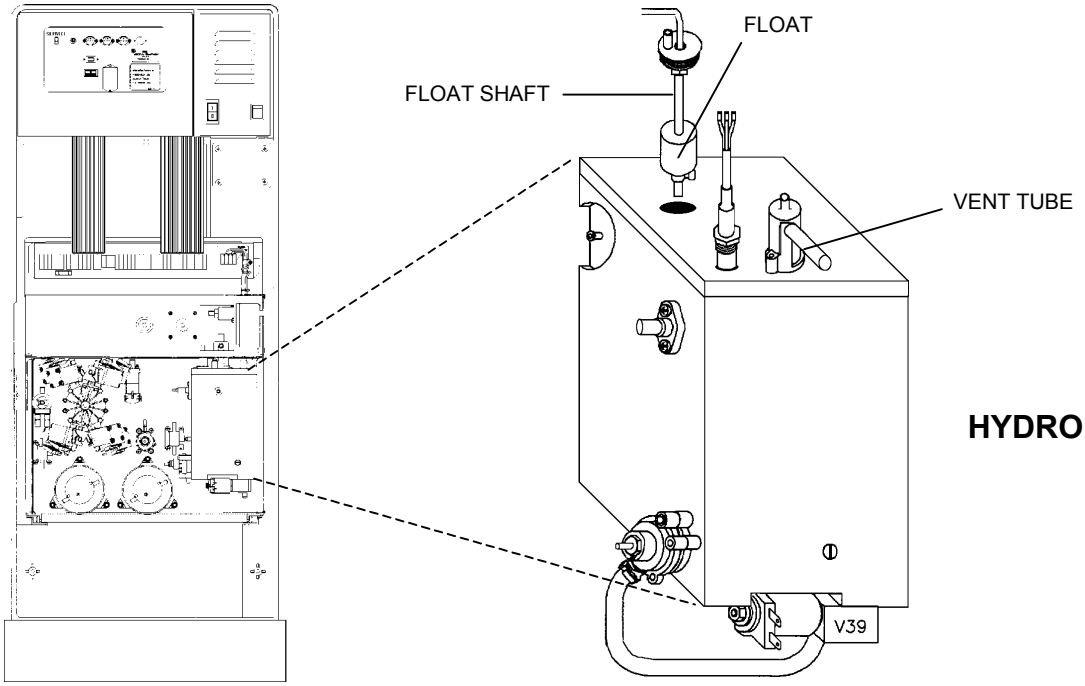
a) Loosen (but don't remove!) the screws that mount the float into the hydroblock (see HYDROBLOCK diagram, next page). **CAUTION!** Don't pull the float's wiring harness.

b) Unplug the float from distribution board position FLOAT-SW. Check inside the distribution board for corroded male pins.

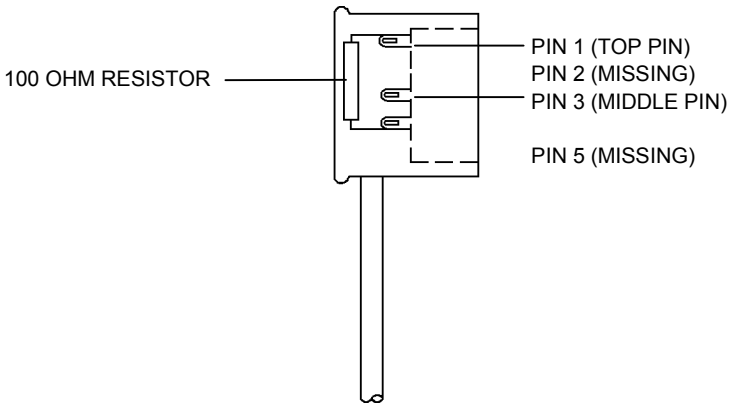
c) Very carefully open the cover on the female connector (see diagram below). Note that pins 2 and 5 are missing. Clip meter leads onto pins 1 and 3 (pin 1 = top of the 100 ohm resistor, pin 3 = middle pin. See FLOAT CONNECTOR diagram below). **CAUTION!** Be careful to clip onto the correct pins!

d) Move the float UP and **FULLY DOWN** twenty times. You should measure about 100 Ω every single time when the float is **FULLY DOWN**. If the float checks good there are four possibilities:

1) Unplug both the actuator and sensor board cables from both ends and check the male connectors and female end for corrosion;
2) Check along the length of the sensor and actuator cables for damage;
3) Check for adequate flow from the incoming water supply;
4) Check incoming water pressure (between 20 and 105 psi).




**HYDROBLOCK**



# SECTION 3 - FLOW ERRORS IN CLEANING PROGRAMS

IMPORTANT NOTE: If flow errors are occurring in HEAT DISINFECT proceed to CP- 1.0.0. If flow errors are occurring in other CLEANING PROGRAMS proceed to CP- 2.0.0.

## CP- 1.0.0 FLOW ERRORS OCCURRING SPECIFICALLY IN HEAT DISINFECT

a) Turn the power off and then back on.

b) Pull the concentrate lines out of the port and place them in concentrate. Place the machine in DIALYZE MODE.

c) Allow temperature to become normal (about 37°C) and call up debug screen 5. Watch FLWERR for three minutes. Does FLWERR = "1" either intermittently or constant?

Yes Return to F- 1.0.0 (page 6).

No See CP- 1.0.1

## CP- 1.0.1 CHECK FOR FLOW ERRORS IN RINSE

a) Place the concentrate lines back into their ports and place the machine into RINSE.

b) Call up debug screen 5 and watch FLWERR for three minutes. Does FLWERR = "1" either intermittently or constant?

Yes Pull the concentrate lines out of the port and place them in concentrate. Place the machine back into DIALYZE MODE and see CP- 3.0.0 (page 26).

No See CP- 1.0.2

## CP- 1.0.2 CHECKING VALVE 39

a) Pull the concentrate lines out of the port and place them in concentrate. Place the machine back into DIALYZE MODE.

b) Check deaeration vacuum per procedure (-24 inHg to -25 inHg). Note the pressure value, leave the gauge in line, and then place the machine into RINSE.

c) Pressure should be at least 10 inHg less than it was in dialyze mode. For example, if you were reading -24 inHg in DIALYZE mode you should read -14 inHg (or less). Is this ok?

Yes If the flow error is occurring only in HEAT DISINFECT, especially after temperature increases, a problem may be indicated with the deaeration pump head or motor.

No Leave the machine in RINSE. A problem is indicated with VALVE 39, the actuator board or the actuator cable. NOTE this and see CHECKING VALVES (page 28).

## CP- 2.0.0 FLOW ERRORS IN RINSE, ACID CLEAN, CHEMICAL CLEAN

NOTE: If the machine will only allow RINSE use another machine's functional board. To avoid calibration reference errors turn functional board switch #7 'on' to enter T & C mode. When troubleshooting is complete put the original board back in.

a) Turn the power off and back on. Connect to concentrate and return to DIALYZE MODE.

b) Allow the machine to run for five minutes.

c) Call up debug screen 5 and watch FLWERR for three minutes. Does FLWERR = "1" either intermittently or constant?

Yes Return to F- 1.0.0 (page 6).

No See CP- 3.0.0

**CP- 3.0.0 CHECK TMP**

In the cleaning modes the dialysate pressure transducer #9 checks for flow. This procedure checks the transducer.

From DIALYZE MODE is the TMP display pegged at either +60 or 520 mmHg?

Yes See CP- 3.0.1

No See CP- 4.0.0

**CP- 3.0.1 RESET TMP**

a) Push and release the RESET button on the front panel. The message "ADJUST TMP?" appears.

b) Immediately push and HOLD the RESET button. After the "ADJUSTING TMP" message is gone does TMP remain (or return) to its pegged value?

Yes See TMP PROBLEMS (page 57).

No See CP- 4.0.0

**CP- 4.0.0 CHECK VALVE 43**

**CAUTION** During these procedures there will be spillage. Move the hydraulics away from the machine to prevent damage.

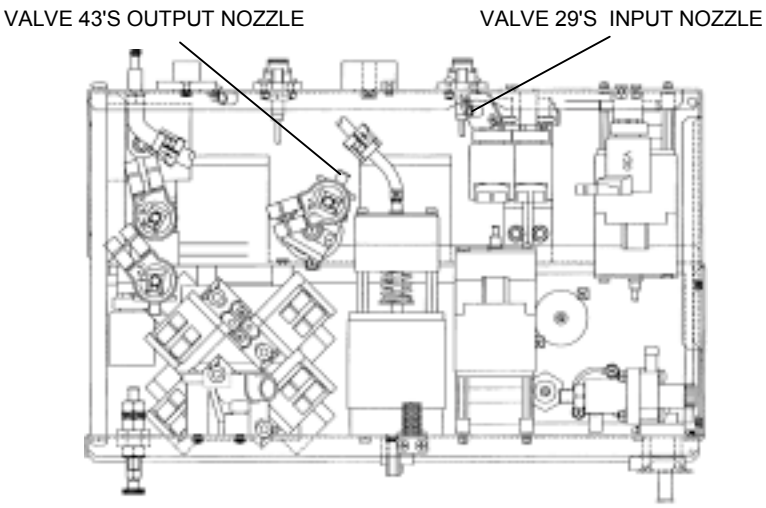
a) Place the dialysate lines into the shunt and the concentrate connectors into their ports.

b) Clamp and remove the clear tubing from valve 43's output nozzle (see diagram below).

c) Put the machine into RINSE and call up debug screen 20. When V43= "1" the actuator board is sending a signal to open valve 43. This occurs every two minutes for several seconds. When V43= "1" is there flow from valve 43?

Yes Place the tubing back onto valve 43, REMOVE the clamp, and see CP- 5.0.0

No Leave the machine in RINSE. A problem is indicated with **VALVE 43**, the actuator board or the actuator cable. **NOTE** this and see CHECKING VALVES (page 28).




**HYDRAULICS, TOP VIEW**

**CP- 5.0.0 CHECK VALVE 29**

a) With the machine in RINSE, clamp the clear tubing at valve 29's input nozzle as close to the valve as possible (see diagram above) and then remove the tubing from the valve.

b) Fill a syringe with water. Using the same size tubing from valve 29 attach the syringe to valve 29's input nozzle.

c) From debug screen 20, when V29 = "1" the actuator board is sending a signal to open valve 29. This occurs ONLY for a few seconds every two minutes so be ready! When V29= "1" are you able to push water through the valve with the syringe?

Yes If flow errors continue an intermittent bad dialysate pressure transducer may be indicated or a bad deaeration pump head may be indicated.

No Leave the machine in RINSE. A problem is indicated with **VALVE 29**, the actuator cable or the actuator board. **NOTE** this and see CHECKING VALVES (page 28).

# CHECKING VALVES

a) Proceed ONLY with the NOTED valve. Unplug the valve from its distribution board position (see table below) and check for bent, broken or corroded male pins.

b) From the indicated program mode (see table below) carefully measure dc voltage, inside the distribution board, between male pins 1 and 5 (top and bottom). Follow the instructions given.

| VALVE | DISTRIBUTION POSITION | PROGRAM MODE | GOOD | BAD = LESS THAN 20 VDC |
|---|---|---|---|---|
| 24 | V24, DIAL-V1 | RINSE | [1]Pulsing on and off, see CV- 1.0.0 | Two possibilities:<br>1) [2]Bad actuator cable<br>2) Bad actuator board |
| 41 (27) | V27 | DIALYSIS | 22 to 26 vdc, see CV- 1.0.0 | Two possibilities:<br>1) [2]Bad actuator cable<br>2) Bad actuator board |
| 39 | V39, DEAR-V | RINSE | 22 to 26 vdc, see CV- 1.0.0 | Two possibilities:<br>1) [2]Bad actuator cable<br>2) Bad actuator board |
| 29 | V29, REC-V | RINSE | 22 to 26 vdc ONLY when debug screen 20, V29 = 1, see CV- 1.0.0 | Two possibilities:<br>1) [2]Bad actuator cable<br>2) Bad actuator board |
| 43 | V43 | RINSE | 22 to 26 vdc ONLY when debug screen 20, V43 = 1, see CV- 1.0.0 | Two possibilities:<br>1) [2]Bad actuator cable<br>2) Bad actuator board |

[1] In RINSE, voltage to valve 24 'pulses' on and off from between 26 to 22 vdc (on) to less than 2 vdc.

[2] The actuator cable can be checked for continuity. **NOTE** the specific **VALVE** whose connection you are checking and see CHECKING THE ACTUATOR CABLE (page 72).

## CV- 1.0.0 CHECK FOR AN OPEN

Open the plastic cover of the female distribution board connector. Leaving it unplugged measure resistance between pins 1 and 5 (wires connected) inside the female connector. 50 to 80 Ω?

Yes The valve is bad or possibly restricted.

No Leave the connector unplugged for now and see CV- 1.0.1

## CV- 1.0.1 CHECK SOLENOID RESISTANCE

A two-wire harness runs from the female connector and plugs onto two terminals at the valve's solenoid. See diagrams (page 32) to locate valves. Leaving the female connector unplugged measure resistance between the male solenoid terminals. 50 to 80 Ω ?

Yes The harness between the distribution board and the solenoid is bad.

No Replace the valve.

# TROUBLESHOOTING VALVES

a) Proceed **ONLY** with the **NOTED** valve. Unplug the valve at the distribution board (see table below) and check for bent, broken or corroded male pins.

b) From the indicated program mode (see table below) measure voltage, inside the distribution board, between male pins 1 and 5 (top and bottom). Follow the instructions given.

| VALVE | DISTRIBUTION POSITION | PROGRAM MODE | GOOD | BAD |
|---|---|---|---|---|
| 25 | V25, DIAL-V2 | SELECT ANY PROGRAM | 22 to 26 vdc, valve 25 is bad or possibly restricted | Less than 20 vdc, Bad actuator board |
| 26 | V26, BYPASS-V | RINSE | [1]Pulsing on and off, valve 26 is bad or possibly restricted | Less than 20 vdc, Bad actuator board |
| 30 | V30, DRAIN-V | DIALYZE | 22 to 26 vdc, valve 30 is bad or possibly restricted | Less than 20 vdc, Bad actuator board |

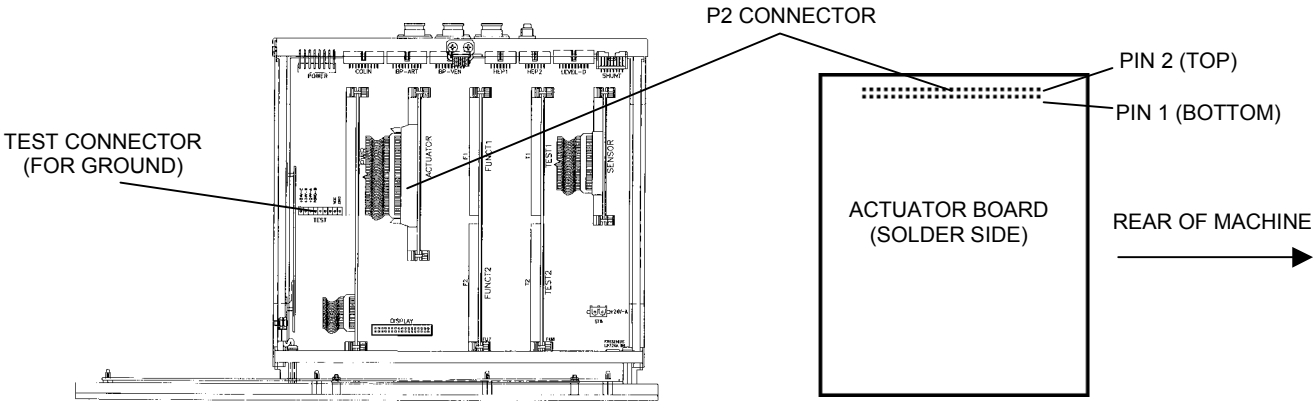
[1] In RINSE, voltage to valve 26 'pulses' on and off from between 26 to 22 vdc (on) to less than 2 vdc.

## TROUBLESHOOTING VALVE ERRORS

Proceed **ONLY** with the **NOTED** valve(s).

a) Turn the power off and clip a ground lead onto PGND-B at the TEST connector (see diagram, below).

b) At the top of the actuator board (see diagram below) there is a large 50-pin connector called the 'P2'. A ribbon cable plugs in here that runs to the distribution board.




**CARD CAGE**

c) Measure resistance at the solder (back) side pins of the P2 connector as directed in the table. See **TABLE 1** to check VALVES 30, 26 and 25 (as prompted from steps 1 or 3, F- 5.0.1). See **TABLE 2** to check the **BALANCING CHAMBER VALVES** (as prompted from step 2, F- 5.0.1). Follow directions given:

**TABLE 1 (from step 1 or 3, F- 5.0.1) TO CHECK VALVES 30, 26 AND 25**

| VALVE | PIN | P2 PIN LOCATION | GOOD = BETWEEN 50 AND 80 Ω | BAD = LESS THAN 50 OR GREATER THAN 80 Ω (NOTE M Ω = MEG OHMS) |
|---|---|---|---|---|
| 30 | 35 | bottom row, 8 pins from front | Check also valve 26 | Greater than 80, See VE- 1.0.0<br>Less than 50, See VE- 1.0.4 |
| 26 | 31 | bottom row, 10 pins from front | See VE- 1.0.2 | Greater than 80, See VE- 1.0.0<br>Less than 50, See VE- 1.0.4 |
| 25 | 30 | top row, 11 pins from front | See VE- 1.0.2 | Greater than 80, See VE- 1.0.0<br>Less than 50, See VE- 1.0.4 |

**TABLE 2 (from step 2, F- 5.0.1) TO CHECK BALANCING CHAMBER VALVES**

| VALVE | PIN | P2 PIN LOCATION | GOOD = BETWEEN 50 AND 80 Ω | BAD = LESS THAN 50 OR GREATER THAN 80 Ω (NOTE M Ω = MEG OHMS) |
|---|---|---|---|---|
| 31 | 36 | top row, 8 pins from front | Check also valve 32 | Greater than 80, See VE- 1.0.0<br>Less than 50, See VE- 1.0.4 |
| 32 | 37 | bottom row, 7 pins from front | Check also valve 33 | Greater than 80, See VE- 1.0.0<br>Less than 50, See VE- 1.0.4 |
| 33 | 38 | top row, 7 pins from front | Check also valve 34 | Greater than 80, See VE- 1.0.0<br>Less than 50, See VE- 1.0.4 |
| 34 | 39 | bottom row, 6 pins from front | Check also valve 35 | Greater than 80, See VE- 1.0.0<br>Less than 50, See VE- 1.0.4 |
| 35 | 40 | top row, 6 pins from front | Check also valve 36 | Greater than 80, See VE- 1.0.0<br>Less than 50, See VE- 1.0.4 |
| 36 | 41 | bottom row, 5 pins from front | Check also valve 37 | Greater than 80, See VE- 1.0.0<br>Less than 50, See VE- 1.0.4 |
| 37 | 42 | top row, 5 pins from front | Check also valve 38 | Greater than 80, See VE- 1.0.0<br>Less than 50, See VE- 1.0.4 |
| 38 | 43 | bottom row, 4 pins from front | See VE- 1.0.2 | Greater than 80, See VE- 1.0.0<br>Less than 50, See VE- 1.0.4 |

## VE- 1.0.0 CHECK FOR AN 'OPEN' CIRCUIT

Unplug the **NOTED** valve from the distribution board (for example, valve 36 plugs into position V36) and open the plastic cover from the female connector. Leaving the female connector unplugged measure between pins 1 and 5 (where the wires are soldered) inside the female connector. Between 50 and 80 Ω?

Yes See VE- 1.0.4

No See VE- 1.0.3

## VE- 1.0.2 CHECK ACTUATOR BOARD CABLE

Unplug the actuator board cable from both ends (the cable terminates at distribution board's ACTUATOR connector): a) Using a flashlight check the male side of each connector for (white) corrosion. Check also for bent or broken pins; b) Check the female side of both connectors for (white) corrosion. If ok replace the actuator cable.

## VE- 1.0.3 CHECK VALVE SOLENOID

Each valve has a two-pin wiring harness that runs from the distribution board and terminates at its solenoid where it plugs onto *two male terminals (see the diagrams (next page) to locate the **NOTED** valve). Unplug the harness and measure between the male solenoid terminals. Between 50 and 80 Ω?

Yes The wiring harness is bad.

No Replace the valve.

* Some harnesses may wire directly into the solenoid. If so replace the valve.

## VE- 1.0.4 CHECK ACTUATOR BOARD CABLE

Unplug the actuator cable from the distribution board (ACTUATOR connector). Leave the actuator board side plugged in. Measure again at the **NOTED** valve's actuator board P2 connector pin (as instructed above). Greater than 2 MΩ now?

Yes See VE- 1.0.5

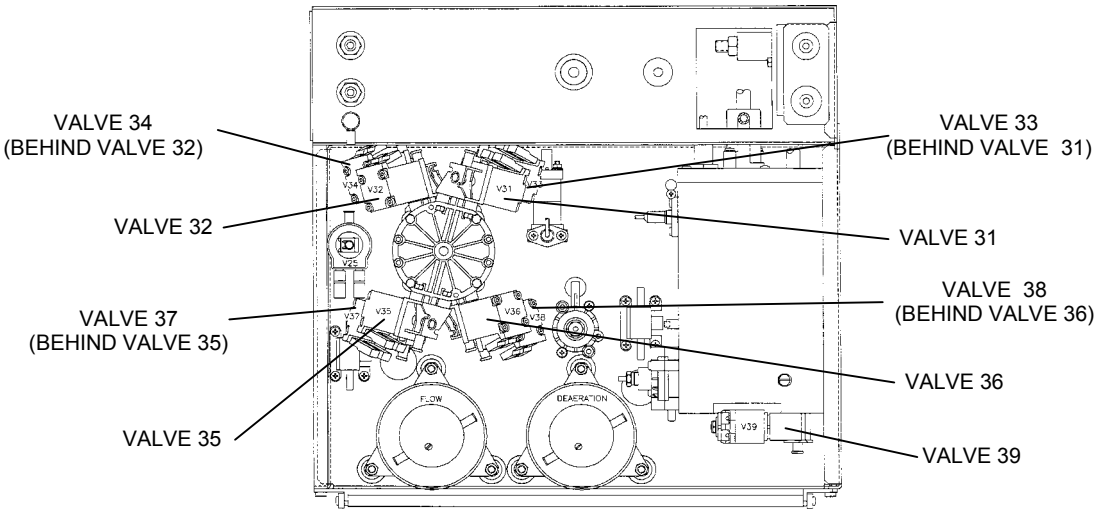
No Unplug the actuator cable from the actuator board itself and measure again at the **NOTED** valve's actuator board P2 connector pin (as instructed above). If less than 2 MΩ replace the actuator board (shorted driver) otherwise proceed to VE- 1.0.5

## VE- 1.0.5 CHECK ACTUATOR CONNECTOR PINS/ VALVE HARNESS

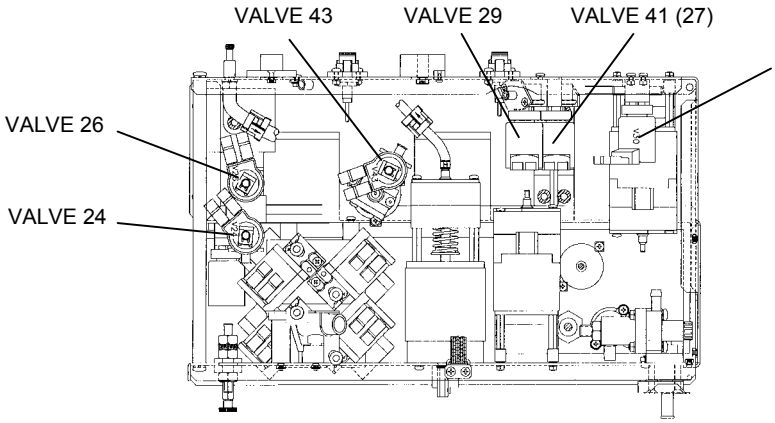
a) Using a flashlight check for bent or (white) corroded male pins at each connector (both at the actuator board and distribution board side).

b) Check the 2-pin wiring harness that runs from the NOTED valve's solenoid to the distribution board. If damage is seen replace the harness.

c) Plug all cables back in and place the machine back into dialyze mode. If the VALVE ERROR continues there are two possibilities: 1) Bad actuator board; 2) Bad actuator cable.




**HYDRAULICS, REAR VIEW**




**HYDRAULICS, TOP VIEW**

# SECTION 4 - TEMPERATURE PROBLEMS

**CAREFULLY** read the list of symptoms and proceed with the one that best describes the problem:

1. TEMP display remains at 33°C; a) Check that the heater breaker switch is on i.e "1" is pushed in (see diagram A, page 5); b) If the problem is still present after 10 minutes see T- 1.0.0

2. TEMP display increases to about 40°C, falls and then rises again. See T- 4.0.0

3. You are currently attempting HEATER CONTROL CALIBRATION but it does not calibrate properly: a) Check that the heater breaker switch is on i.e."1" is pushed in (see diagram A, page 5); b) If 'measured' temperature increases to 40°C (or greater) causing no flow through the external flow indicator RETURN to DIALYZE mode and see T- 4.0.0; c) If parts a and b do not describe the problem RETURN to DIALYZE mode and see T- 1.0.0.

4. The machine is currently in HEAT DISINFECT and:

    - TEMPERATURE remains at 33°C; a) Check that the heater breaker switch is on i.e."1" is pushed in (see diagram A, page 5); b) If the problem is still present after 10 minutes RETURN to DIALYZE mode and see T- 1.0.0

    - TEMPERATURE fails to reach 80°C but is greater than 33°C. See T- 3.0.0

    - TEMPERATURE increases to about 90°C, falls and then rises again. See T- 4.0.0

5. TEMP display and measured 'actual' temperature are not the same. Watch VERY carefully for 10 minutes to assure that the TEMP display is remaining stable. If so see T- 5.0.0

## T- 1.0.0 CHECK FOR NO WATER, FLOW ERROR AND FILLING PROGRAM

a) Call up debug screen 5 and carefully watch !WATER and FLWERR for two minutes. If either goes to "1" (intermittently or constant) see FLOW ERRORS IN DIALYZE MODE (page 6).

b) Call up debug screen 7. If FILACT = "1" a FILLING PROGRAM is present. Do **NOT** troubleshoot TEMPERATURE PROBLEMS with a FILLING PROGRAM present. If FILACT = "0" proceed to T- 1.0.1

## T- 1.0.1 CHECK TEMP SET POINT

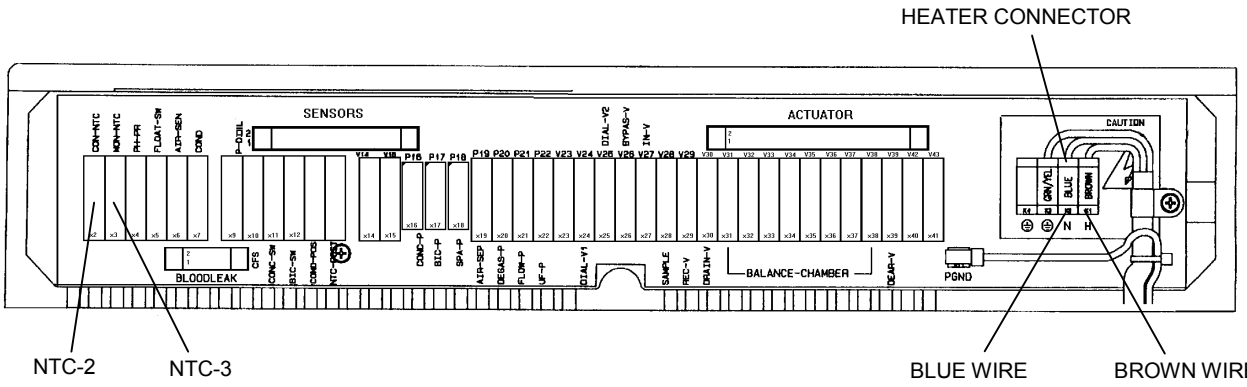
From the main DIALYSIS screen use the arrow keypads to select TEMP and push the SET keypad to make a "?" appear. The indicated TEMP value is the current 'set point'. If necessary use the arrows keypads to adjust 'set point' and push the SET keypad again. Allow 10 minutes for stabilization. If adjustment is not necessary or if the problem is still present see T- 1.0.2.

## T- 1.0.2 CHECK HEATER VOLTAGE

**CAUTION 120 VAC!.** Measure ac voltage, between the **BLUE** and **BROWN** heater wires at the distribution board's heater connector (see diagram, next page). Voltage may be 'pulsing' causing the meter to O.L. intermittently (this is normal). Greater than 90 vac?

Yes See T- 1.0.3

No See T- 2.0.0




## T- 1.0.3 CHECK HEATER

IMPORTANT turn the POWER OFF. Measure RESISTANCE between the **BLUE** and **BROWN** heater wires (see diagram above). Between 10 and 13 Ω?

Yes See T- 5.0.0 (page 43).

No Replace the heater.

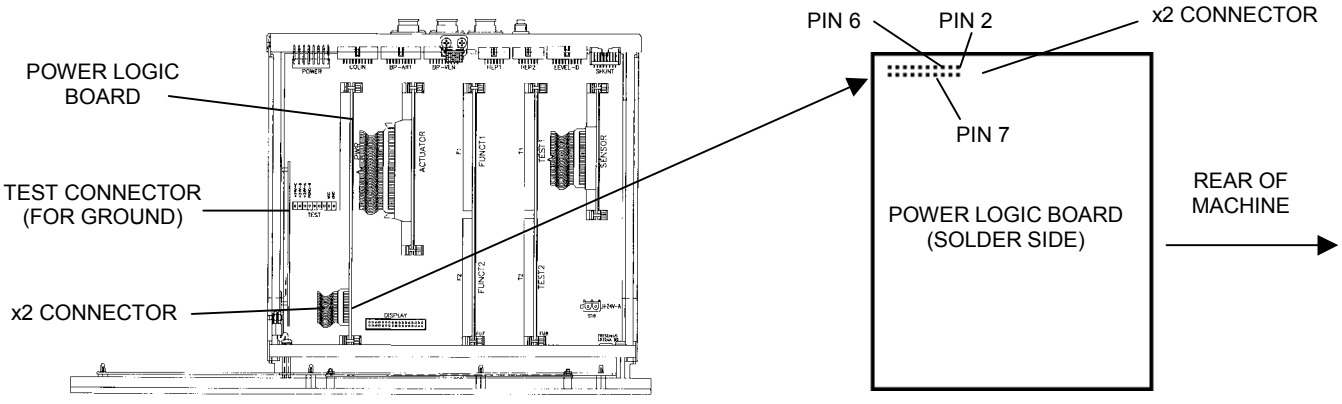
## T- 2.0.0 CHECK LOGIC SIGNALS

CAUTION During these procedures dc voltages are measured at the solder (back) side of the POWER LOGIC BOARD'S x2 connector. The pins are very close to each other and 'shorting' them together with a meter probe can damage the board. It is RECOMMENDED that you use TP80 (non-standard) meter probes together with the slip-on cap.

a) Turn the power off and clip a ground lead onto SGND at the TEST connector (see diagram below).

b) At the top, very front of the POWER LOGIC BOARD is the 20-pin 'x2' connector (see diagram below). A ribbon cable terminates here that runs into the upper power supply. The solder side pins are arranged in two rows. Top are the even numbered, bottom are odd.

c) Turn the power on and go to DIALYZE MODE by pushing the SET twice button. Measure at the pins specified in the LOGIC SIGNALS table (next page) and follow the directions given:



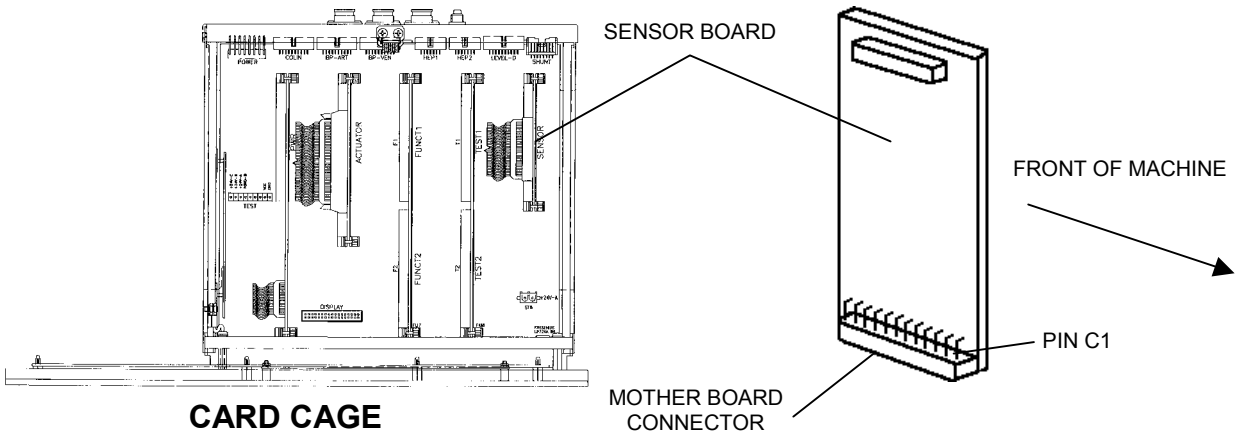

**CARD CAGE**

LOGIC SIGNALS

| PIN | x2 LOCATION | GOOD SIGNAL (vdc) | BAD SIGNAL (vdc) |
|---|---|---|---|
| 6 | top row, three pins from the rear | 9.6 or greater, measure at x2, pin 7 | 3.6 or lower, see T- 2.1.0 |
| 7 | bottom row, four pins from the rear | 4 or greater, measure at x2, pin 2 | 1.5 or lower, see T- 2.2.0 |
| 2 | top row, first pin from the rear | 2 or lower, see T- 2.4.0 | 22 to 26, see T- 2.3.0 |

## T- 2.1.0 CHECK SENSOR BOARD SIGNAL

a) At the very BOTTOM, left hand side (component side) of the SENSOR board is its motherboard connector (see CARD CAGE diagram below). A row of pins extend horizontally, turns 90 degrees downward and runs into the connector. This is the "C row", numbered 1 through 32 (from front-to-rear).




**CARD CAGE**

b) Using a STANDARD meter probe (do NOT use the non-standard probe) CAREFULLY measure voltage at pin C1 (very FRONT motherboard pin). High (9.6 vdc or greater) or low (less than 3.6 vdc)?

High See T- 2.1.2

Low See T- 2.1.1

## T- 2.1.1 CHECK POWER LOGIC BOARD

a) Turn the power off and swap in a power logic board.

b) Turn the power on and measure again at the power logic board's x2 connector, pin 6. High (9.6 vdc or greater) or low (3.6 vdc of lower)?

High The previous power logic board is bad.

Low See T- 2.5.0 (the previous power logic board is good).

## T- 2.1.2 CHECK NTC-2

Unplug NTC-2 from the distribution board (FIRST! position on left, x2 CON-NTC). Does pin C1 go low?

Yes Replace NTC-2.

No See T- 2.1.3

## T- 2.1.3 CHECK NTC-2 CIRCUIT

a) Turn the power off and unplug both ends of the 34-pin sensor board cable. Check for bent, broken or corroded male pins at each connector.

b) Plug the cable back in and swap a power logic board.

c) Turn the power back on and measure again at the sensor board's motherboard pin C1. High (9.6 vdc or greater) or low (3.6 vdc or lower)?

High Replace the sensor board (the previous power logic board is good).

Low The previous power logic board is bad

## T- 2.2.0 CHECK FOR FLOW ERRORS

Call up debug screen 5. Is FLWERR = "1"?

Yes See FLOW ERRORS IN DIALYZE MODE (page 6).

No See T- 2.2.1

## T- 2.2.1 CHECK ACTUATOR BOARD

a) Turn the power off and swap in an actuator board.

b) Turn the power on and go to DIALYZE MODE by pushing the SET button twice.

c) Measure again at the power logic board's x2 connector, pin 7. High (greater than 4 vdc) or low (less than 1.5 vdc)?

High The previous actuator board is bad.

Low See T- 2.5.0 (the previous actuator board is good).

## T- 2.3.0 CHECK POWER LOGIC/FUNCTIONAL BOARD

a) Turn the power off and swap in a power logic board.

b) Turn the power on and go to DIALYZE MODE by pushing the SET button twice. Wait 15 seconds.

c) Measure again at the solder side of the power logic board's x2 connector, pin 2 (top row, first pin from rear). Less than 2 vdc now?

Yes The previous power logic board was bad.

No Replace the functional board (the previous power logic board is good).

## T- 2.4.0 CHECK HEATER RELAY

a) Turn the power off and then back on. Allow the SELECT PROGRAM screen to come up. IMPORTANT! Do NOT enter dialyze mode.

b) From SELECT PROGRAM measure again at the solder side of the power logic board's x2 connector, pin 2 (top row, first pin from rear). Approximately 24 ± 2.0 vdc?

Yes See T- 2.6.0

No See T- 2.5.0

## T- 2.5.0 CHECK POWER LOGIC CABLE/POWER CONTROL BOARD

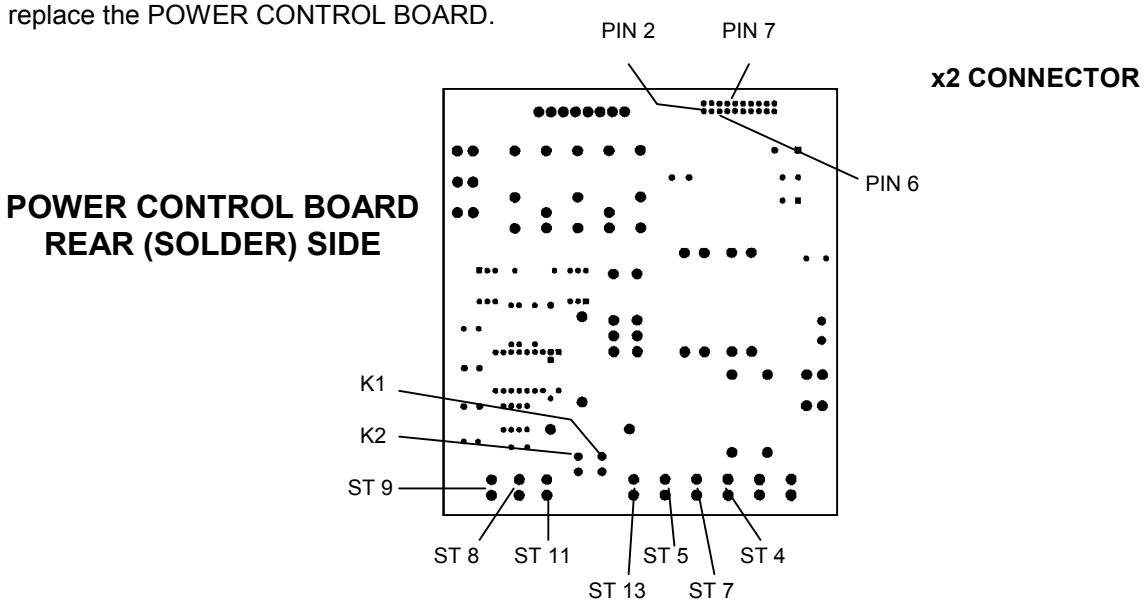
Either the 20-pin power logic board cable or the power control board is bad.

a) Turn the power off and UNPLUG the machine. CAUTION, 120 VAC IF NOT UNPLUGGED!

b) Slide the upper power supply (see diagram A, page 5) away from the cabinet. Inside is the power control board where the 20-pin 'x2' cable terminates. Check that the cable is plugged in properly.

c) Unmount the power control board from the plastic clips to allow easy access to the rear (solder) side (see diagram below).

d) Measure resistance from pin 2, at the POWER LOGIC BOARD'S end of the cable (x2 connector, top row, first pin from rear), to pin 2 at the POWER CONTROL BOARD'S end. If the cable is good (10 Ω or less) replace the POWER CONTROL BOARD.




## T- 2.6.0 CHECK POWER LOGIC BOARD CABLE

a) Turn the power off and UNPLUG the machine. CAUTION, 120 VAC IF NOT UNPLUGGED!

b) Slide the upper power supply (see diagram A, page 5) away from the cabinet. Inside is the power control board where the 20-pin 'x2' cable terminates. Check that the cable is plugged in properly.

c) Unmount the power control board from the plastic clips to allow easy access to the rear (solder) side (see diagram above). Measure resistance from (two measurements):

1) Pin 6, at the POWER LOGIC BOARD'S end of the cable (x2 connector, top row, three pins from rear), to pin 6 at the POWER CONTROL BOARD'S end (see diagram above).

2) Pin 7, at the POWER LOGIC BOARD'S end of the cable (x2 connector, bottom row, four pins from rear), to pin 7 at the POWER CONTROL BOARD'S end (see diagram above).

d) If the cable is good (10Ω or less) see T- 2.6.1

## T- 2.6.1 CHECK TRIAC VOLTAGE DROP

a) Set meter to ac volts and CLIP the leads, onto the SOLDER side of the power control board, at connectors ST 8 and ST 11 (see diagram, previous page).

b) Plug the machine in. CAUTION, 120 VAC NOW PRESENT!

c) Turn the power on and go to DIALYZE MODE by pushing the SET button twice. Wait 15 seconds. Greater than 90 vac across the triac?

Yes See T- 2.6.2

No See T- 2.7.0

## T- 2.6.2 CHECK TRIAC GATE SIGNAL

a) Turn the POWER OFF and UNPLUG the machine.

b) CLIP the meter leads, onto the SOLDER side of the power control board at connector K 2 and terminal ST9 (see diagram, previous page).

c) Plug the machine in. CAUTION, 120 VAC NOW PRESENT!

d) Turn the power on and go to DIALYZE MODE by pushing the SET button twice. Wait 15 seconds. 90 vac or greater?

Yes Bad power control board.

No Bad triac (trace the orange wire from connector ST 9 down to the triac).

## T- 2.7.0 CHECK HEATER CONNECTIONS

a) Turn the POWER OFF and UNPLUG the machine.

b) Measure resistance, on the SOLDER side of the power control board, between connectors K 2 and K 1 (see diagram, previous page). Less than 20 Ω (ohms)?

Yes See T- 2.7.1

No Check for an 'open' circuit to the heater.

## T- 2.7.1 CHECK HEATER BREAKER

a) Referring to the diagram on the previous page measure resistance, on the SOLDER side of the power control board, BETWEEN connectors:

1) ST 7 and ST 13

2) ST 4 and ST 5

b) Both less than 30 ohms?

Yes See T- 2.7.2

No Replace the heater breaker. It is 'open'.

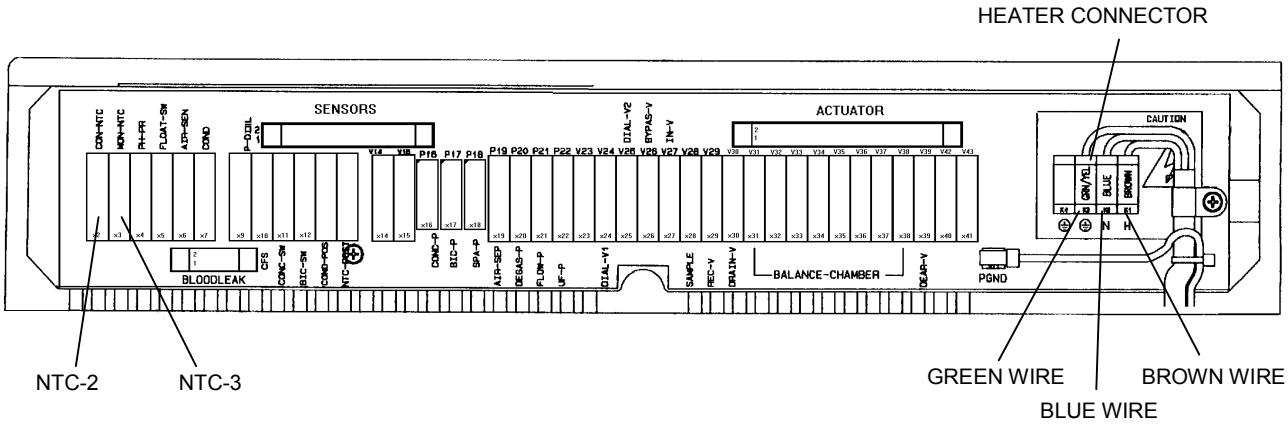
## T- 2.7.2 CHECK HEATER VOLTAGE

a) Turn the power on and go to DIALYZE MODE by pushing the SET button twice.

b) CAUTION 120 VAC!. Measure ac voltage, between the GREEN and BROWN heater wires at the distribution board's heater connector (see diagram below). Greater than 90 vac?

Yes Everything is checking good. If the temperature problem is still present return to T- 1.0.0 and proceed carefully.

No Replace the power control board (inside upper power supply).




## T- 3.0.0 CHECK HEATER

a) Turn the heater breaker switch off (see diagram A, page 5) and allow the TEMP display to reach 33°C.

b) Turn the POWER OFF and measure RESISTANCE, between the BROWN and BLUE heater wires at the distribution board's heater connector (see diagram above). Between 10 and 13 Ω?

Yes Turn the heater breaker switch back on and see T- 3.0.1

No Replace the heater

## T- 3.0.1 CHECK TEMPERATURE DISPLAY

a) Place the machine in DIALYZE MODE (this procedure does not work in HEAT DISINFECT).

b) Plug the 40°C Fresenius temperature 'dummy' connector into NTC-3's distribution board position (MON-NTC, SECOND! position from the left). CAUTION! Be careful to plug into the correct position.

c) Does the TEMP display (main screen) read between 38 and 42°C?

Yes See T- 3.0.2

No See T- 6.0.0 (page 43).

## T- 3.0.2 CHECK RECIRCULATION

Return to HEAT DISINFECT and call up debug screen 20. When V29 = "1" the actuator board is opening recirc valve 29. Wait until V29 = "1" CONSTANTLY. Is there flow to the drain?

Yes See T- 3.0.3

No Note that NTC-2 OR NTC-3 may be a problem and see T- 9.0.0 (page 44).

## T- 3.0.3 CHECK VALVE 30

Unplug valve 30 from the distribution board (position V30). Does flow to the drain stop?

Yes Replace the actuator board.

No Replace valve 30.

## T- 4.0.0 CHECK SENSOR BOARD SIGNAL

a) Turn the power off and clip a ground lead onto SGND at the TEST connector (see diagram below).

NOTE: Troubleshooting this symptom **CANNOT** be done in HEAT DISINFECT. If currently in HEAT DISINFECT return to **DIALYZE MODE**.

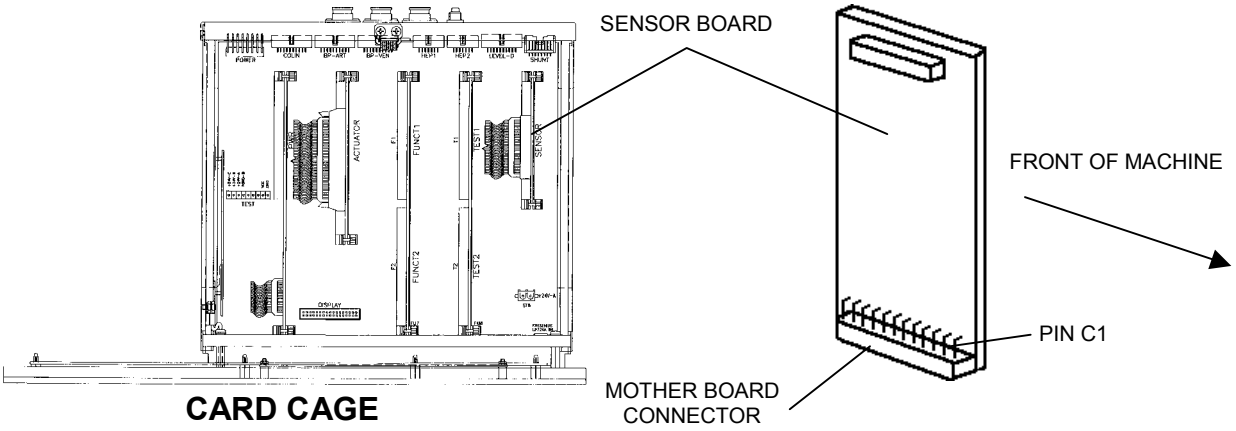
b) Plug the 80°C Fresenius test (temperature) 'dummy connector' into NTC-2's distribution board position (FIRST! position on the left, CON-NTC). CAUTION! Be careful to plug in correctly!

c) At the very BOTTOM, left hand side (component side), of the SENSOR board is its motherboard connector (see CARD CAGE diagram below). A row of pins extend horizontally, turns 90 degrees downward, and runs into the connector. This is the "C row", numbered 1 through 32 (from front-to-rear).

d) Turn the power on. Using a STANDARD meter probe (do not use the non-standard probe) CAREFULLY measure dc voltage at pin C1 (very FRONT motherboard pin). High (9.6 vdc or greater) or low (less than 3.6 vdc)?

High Leave the 'dummy' in for now and see T- 4.1.0

Low Note that NTC-2 may be a problem and see T- 9.0.0 (page 44).

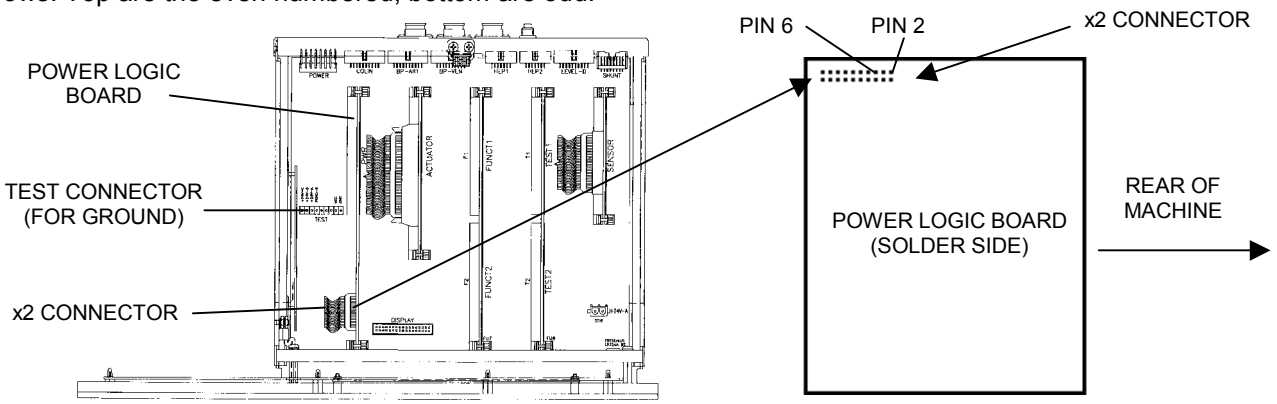



**CARD CAGE**

## T- 4.1.0 CHECK LOGIC SIGNAL

**CAUTION** During these procedures dc voltages are measured at the solder (back) side of the POWER LOGIC BOARD'S x2 connector. The pins are very close to each other and 'shorting' them together with a meter probe can damage the board. It is RECOMMENDED that you use TP80 (non-standard) meter probes together with the slip-on cap.

a) At the top, very front of the POWER LOGIC BOARD is the 20-pin 'x2' connector (see diagram below). A ribbon cable terminates here that runs into the upper power supply. The solder side pins are arranged in two rows. Top are the even numbered, bottom are odd.




**CARD CAGE**

b) Turn the power on and measure at the solder side of the x2 connector, pin 6 (top row, 3 pins from rear). High (greater than 9.6 vdc) or low (less than 3.6 vdc)?

High See T- 4.2.0

Low Watch the TEMP display (main screen) for 8 minutes (as necessary). Drop to 33°C?

Yes Replace NTC- 2

No Continues to increase to about 40°C (or greater), see T- 4.3.0.

## T- 4.2.0 CHECK POWER LOGIC BOARD

a) Turn the power off and swap the power logic board.

b) Turn the power back on and go to DIALYZE MODE. Watch for 10 minutes. If TEMP continues to increase to about 40°C replace the power control board (inside the upper power supply). The previous power logic board is good.

## T- 4.3.0 CHECK FOR A SHORTED TRIAC

a) Turn the power off and UNPLUG the machine. CAUTION, 120 VAC IF NOT UNPLUGGED!

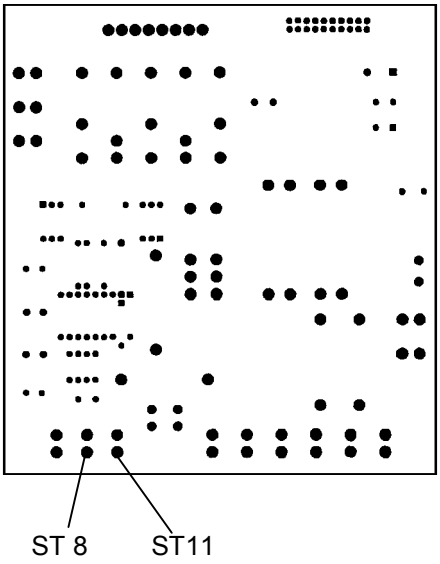
b) Unmount the upper power supply from the cabinet (see diagram A, page 5). Inside is the power control board which is mounted to the case with plastic clips. Unmount the board from the clips to allow easier access to the back (solder) side of the board.

c) Measure resistance, on the solder side of the power control board, between connectors ST 8 and ST 11 (see SOLDER SIDE diagram, next page). Greater than 3 Meg Ω?

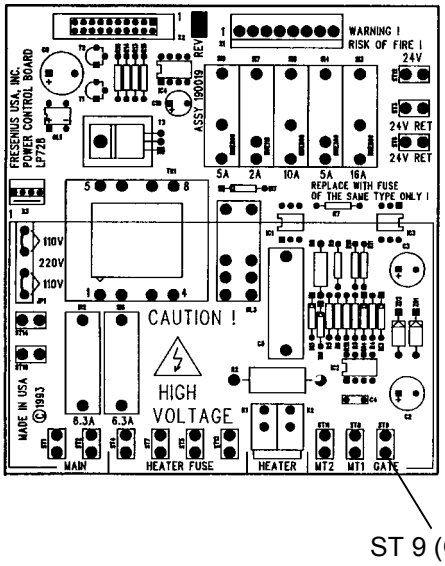
Yes See T- 4.4.0

No Replace the triac (trace the blue, brown and orange wires to it).

**POWER CONTROL BOARD SOLDER SIDE**




**POWER CONTROL BOARD FRONT SIDE**




## T- 4.4.0 CHECK TEMP CALIBRATION

a) Turn the power off and place the machine in SERVICE/CALIBRATION. Connect a temperature meter into the dialysate lines to measure 'actual' temperature. CAUTION Fluid may be hot!

b) Turn the power back on and enter HEAT TEMP CONTROL. Lower the DAC value to "0".

c) Watch 'actual' temperature for 8 minutes. Continue to increase to high?

Yes Leave the temperature meter in line for now and see T- 4.5.0

No Plug NTC-2 back into the distribution board (FIRST! position on the left, CON-NTC) and calibrate HEATER TEMP CONTROL.

## T- 4.5.0 REMOVE TRIAC'S GATE SIGNAL

a) Turn the power off and UNPLUG the machine. CAUTION, 120 VAC IF NOT UNPLUGGED!

b) Unplug the female terminal connector from the power control board's (GATE) terminal ST 9 (see FRONT SIDE diagram above).

c) Wrap BLACK tape around the female terminal connector. CAUTION! The connector is 'live' (120 vac) when the power is on. Damage to the machine or electrocution may occur if not wrapped.

d) Plug the machine in (CAUTION, 120 VAC NOW PRESENT!). Turn the power on and enter CALIBRATION/HEAT TEMP CONTROL.

e) Lower the DAC value to "0" and watch 'actual' temperature for 8 minutes. Continue to increase to high?

Yes Replace the triac and calibrate HEATER TEMP CONTROL.

No Replace the power control board and calibrate HEATER TEMP CONTROL.

## T- 5.0.0 CHECK TEMP DISPLAY

Plug the 40°C Fresenius test (temperature) 'dummy connector' into NTC-3's position (SECOND! position from the left, MON-NTC). CAUTION! Plug in correctly. Does the TEMP display (main screen) read between 38 and 42°C?

Yes Note that NTC- 3 may be a problem and see T- 9.0.0 (page 44).

No See T- 6.0.0

## T- 6.0.0 CHECK DEBUG TEMPERATURE VALUES

a) With the 41°C (5.11KΩ) connector plugged in call up debug screen 9 and note TEMP. Good = 8.5 (+/- 1.6) vdc.

b) Call up debug 11 and note ATEM. Good = 7.7 (+/- 0.3) vdc. Refer to DEBUG table below.

**DEBUG TABLE**

| DEBUG 9, TEMP | DEBUG 11, ATEM | RESPONSE |
|---|---|---|
| GOOD | GOOD | See T- 7.0.0 |
| GOOD | BAD | Replace the actuator board |
| BAD | GOOD | Replace the sensor board |
| BAD | BAD | See T- 8.0.0 |

## T- 7.0.0 CALIBRATE TEMP

a) Plug NTC-3 back into distribution board (**SECOND!** position from left, x3 MON-NTC). CAUTION! Be sure to plug in correctly.

b) Calibrate HEATER CONTROL per CALIBRATION PROCEDURES, section 2.5. If not successful note that either NTC- 2 **or** NTC- 3 may be a problem and see T- 9.0.0 (page 44).

## T- 8.0.0 CHECK TEST BOARD

a) Turn the machine off and swap in a test board. **NOTE**: An alternative is to remove IC 4 from the test board. The machine runs ok but will not pass tests.

b) Turn the power on and enter dialyze mode. With the 41°C (5.11KΩ) dummy connector plugged in call up debug screen 9. TEMP = 8.5 (+/- 1.6) vdc?

Yes The previous test board (or IC 4, test board) is bad.

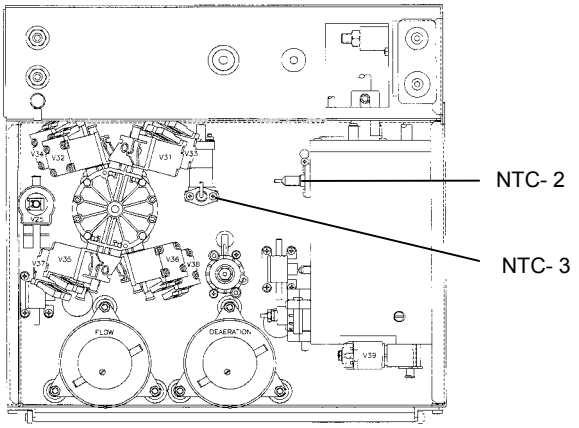
No Four possibilities: 1) *Bad sensor board cable; 2) HEAT TEMP CONTROL not calibrated accurately; 3) Bad sensor board; 4) Bad functional board.

* The sensor cable can be checked for continuity. Note that you are checking **NTC-2** and **NTC-3** connections and see CHECKING THE SENSOR BOARD CABLE (page 74).

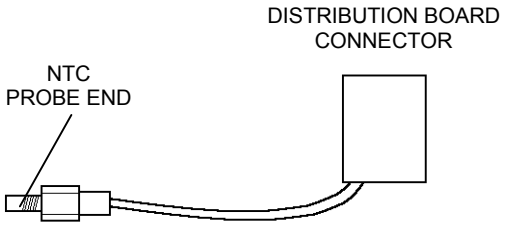
## T- 9.0.0 CHECK NTC RESISTANCE

Proceed **ONLY** with the NTC(s) as noted above.

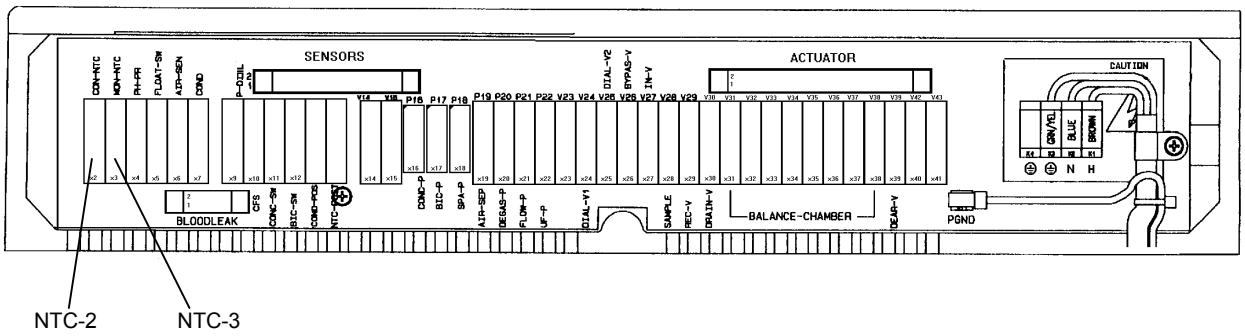
a) Turn the **POWER OFF** and remove the NTC(s) from the respective hydraulic location (see diagram below). This reveals the 'probe' end.




**HYDRAULICS, REAR VIEW**




b) Unplug the NTC from its distribution board connector (see diagram below). Check, inside the distribution board, for bent, broken, or corroded **male** pins.




c) **VERY CAREFULLY**! (thin wires inside!) open the plastic cover from the NTC's female connector. Clip meter leads onto pins 1 and 3 (top and middle, typically green and white wires attached).

d) Draw water, between 36 and 38°C, into a styrofoam cup. Water temperature should be ACCURATELY measured with an **external** thermometer.

e) Drop the 'probe' end into the water and allow the resistance value to stabilize. Refer to the NTC RESISTANCE table (page 45). Replace any NTC that checks bad and calibrate HEAT TEMP CONTROL.

f) If NTC(s) check good there are four possibilities: 1) *Bad sensor board cable; 2) HEAT TEMP CONTROL not calibrated accurately; 3) Bad sensor board; 4) Bad functional board.

* The sensor cable can be checked for continuity. Note that you are checking **NTC-2** and **NTC-3** connections and see CHECKING THE SENSOR BOARD CABLE (page 74).

**NTC RESISTANCE**

| Temperature (°C) | Low Resistance (KΩ) | Nominal Resistance (KΩ) | High Resistance (KΩ) |
|---|---|---|---|
| 36.0 | 6.142 | 6.267 | 6.392 |
| 36.1 | 6.117 | 6.242 | 6.367 |
| 36.2 | 6.092 | 6.217 | 6.342 |
| 36.3 | 6.067 | 6.192 | 6.317 |
| 36.4 | 6.042 | 6.167 | 6.292 |
| 36.5 | 6.017 | 6.142 | 6.267 |
| 36.6 | 5.992 | 6.117 | 6.242 |
| 36.7 | 5.967 | 6.092 | 6.217 |
| 36.8 | 5.942 | 6.067 | 6.192 |
| 36.9 | 5.917 | 6.042 | 6.167 |
| 37.0 | 5.892 | 6.017 | 6.142 |
| 37.1 | 5.868 | 5.993 | 6.118 |
| 37.2 | 5.844 | 5.969 | 6.094 |
| 37.3 | 5.820 | 5.945 | 6.070 |
| 37.4 | 5.796 | 5.921 | 6.046 |
| 37.5 | 5.772 | 5.897 | 6.022 |
| 37.6 | 5.748 | 5.873 | 5.998 |
| 37.7 | 5.724 | 5.849 | 5.974 |
| 37.8 | 5.700 | 5.825 | 5.950 |
| 37.9 | 5.676 | 5.801 | 5.926 |
| 38.0 | 5.652 | 5.777 | 5.902 |

# SECTION 5 - CONDUCTIVITY PROBLEMS

## CO- 1.0.0 CHECK CONCENTRATE

a) If other machines are experiencing the same symptoms there may be a problem with the concentrate batch. Use fresh bicarb.

b) From the VERIFY CONCENTRATE screen assure that the proper concentrate, Na and Bic levels are selected. If not this may be the problem.

c) Assure that the concentrate connectors are plugged into the proper concentrates. If all is ok proceed to CO- 1.0.1

## CO- 1.0.1 CHECK FLOW/TEMPERATURE

a) Call up debug screen 5. If FLWERR = "1" a flow error is present. Do NOT troubleshoot CONDUCTIVITY PROBLEMS until flow errors are clear.

b) Push SET to return to the main screen. Assure TEMP is stable and within (+/-) 0.3 of unit standards. Do NOT troubleshoot CONDUCTIVITY PROBLEMS unless temperature is good.

c) If there are no flow errors or temperature problems proceed to CO- 1.0.2

## CO- 1.0.2 CHECK FOR END OF STROKE (EOS) ERRORS

Call up debug screen 7. Is either NO EOS or ALWEOS ="1"?

Yes See CONCENTRATE PUMP END OF STROKE ERRORS (page 52).

No Proceed accordingly:

1) COND constantly low. See CO- 3.0.0

2) COND constantly high. See CO- 2.0.0

3) COND drifting from good to high. See CO- 2.0.0

4) COND rapidly bouncing from 10 to 17. See CO- 4.0.0 (page 48).

## CO- 2.0.0 CHECK THE 'OUT OF BYPASS' HYDRAULIC CIRCUIT

Place the machine into RINSE and assure that the external flow indicator (75) is vertical. Is the' bob' (inside the indicator) rising?

Yes See CO- 7.0.0 (page 50)

No A flow problem is indicated. See F- 17.0.0 (page 15).

## CO- 3.0.0 CHECK CONCENTRATE SELECTION

From the VERIFY CONCENTRATE screen is Bicarb or Acetate concentrate selected?

Bicarb See CO- 3.0.1

Acetate See CO- 3.0.2

## CO- 3.0.1 CHECK BICARB STEPS

Call up debug screen 0. Is ABIC = "0"? IMPORTANT NOTE: If BIC also = "0" bicarb is NOT selected.

Yes See CO- 8.0.0 (page 51).

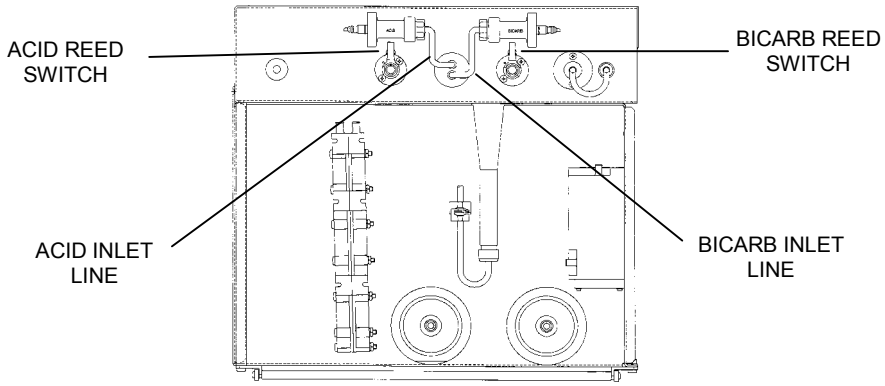
No See CO- 3.0.2

## CO- 3.0.2 CHECK CONCENTRATE INLET

THIS IS AN IMPORTANT STEP! Looking through the acid and bicarb inlet lines (see diagram below) is AIR FREE concentrate being pulled steadily, in one direction only (be certain)?

Yes See CO- 5.0.0 (page 49).

No See CO- 3.0.3




## CO- 3.0.3 CHECK CONCENTRATE CONNECTOR

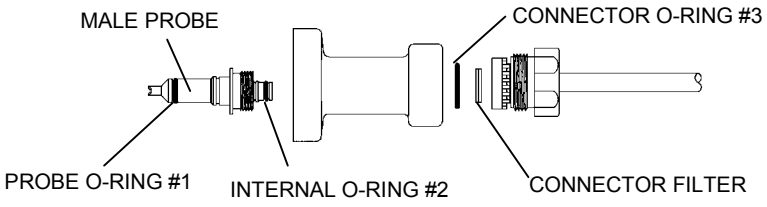
a) Check the concentrate connector filter and o-ring #3 (see diagram below).

b) Place the machine into RINSE mode. Is either concentrate connector leaking?

Yes See CO- 3.0.4

No Allow the machine to run in RINSE for a few minutes (to remove a possible air lock) and return to DIALYZE mode. If the pump still does not draw see CO- 3.0.4

**CONCENTRATE CONNECTOR**



## CO- 3.0.4 CHECK CONNECTOR 0-RINGS

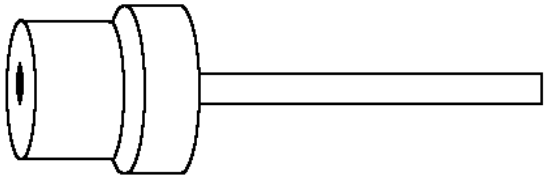
a) Check male probe o-rings #1 and #2 (see diagram, previous page).

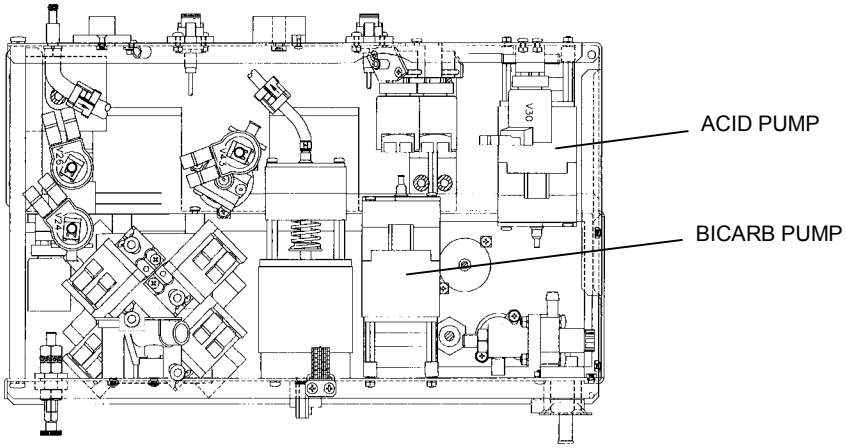
b) If the pump still does not draw, place the entire concentrate connector into water. Does the pump draw now?

Yes The wand is bad (see diagram below).

No Check the concentrate pump for broken springs, bad seals, bad o-rings, bad diaphragm (see diagram below).

**WAND**






**HYDRAULICS, TOP VIEW**

## CO- 4.0.0 CHECK FOR AIR AT CONDUCTIVITY CELL

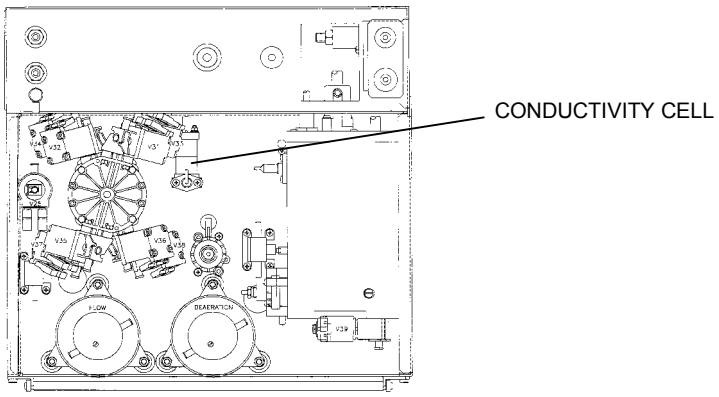
Check the clear tubing at both sides of the conductivity cell (see diagram, next page). Is there excessive air flowing through it?

Yes a) Plug the bicarb connector back into it's port and wait for a few minutes. Check for air again at the cell. If air is not seen a problem is indicated in the bicarb injection system. Check first the bicarbonate connector for bad o-rings.

b) Calibrate DEAERATION PRESSURE by first decreasing the DAC value until pressure is below -18 inHg and then increasing it SLOWLY to -24 inHg.

c) Perform NEGATIVE PRESSURE TESTS (page 62) and INDUCED POSITIVE PRESSURE TESTS (page 65). Look for fluid leaks especially at balancing chamber valves 31 and 33.

No See CO- 4.0.1




**HYDRAULICS, REAR VIEW**

**CO- 4.0.1 CHECK DEBUG CELL VALUES**

Assure that the machine has run for 10 minutes with fresh concentrate connected and call up debug screen 23 (frequency values in Hertz). Is FPRE between 1392 and 3072 Hertz or is it 'bouncing' to greater than 8000 Hertz?

Between See CO- 6.0.0

Bouncing Two possibilities; 1) Bad sensor board; 2) Bad actuator board.

**CO- 5.0.0 CHECK DEBUG CELL VALUES**

Assure that the machine has run for 10 minutes with fresh concentrate connected and call up debug screen 23 (frequency values in Hertz). Is FPRE 1392 and 3072 Hertz?

Yes See CO- 6.0.0

No See CO- 5.0.1

**CO- 5.0.1 PERFORM PRESSURE TEST**

a) Select a flow rate of 500 ml/min, clear blood alarms, and turn the blood pump rate knob clockwise.

b) Select a UF RATE of 1000 ml/hr and turn UF on (green UF on/off LED MUST be on solid and the UF RATE numeric display must NOT blink).

c) Allow TMP increase to about 260 and then turn UF off. Allow 30 seconds for stabilization.

d) After stabilization does TMP remain stable (within +/- 60 mmHg) for three minutes?

Yes Check BALANCING CHAMBER VOLUME and calibrate *ACID and *BICARB PUMP VOLUMES and CONDUCTIVITY CELL per CALIBRATION PROCEDURES.

No See PRESSURE HOLDING TESTS FAILING (page 60).

* While the pumps are drawing concentrate from the burette determine if each is taking CONSTANT volumes per stroke (in one direction ONLY). If not check the pump's springs, seals, and diaphragm.

## CO- 6.0.0 CHECK CONDUCTIVITY CELL

a) Turn flow off and note the FPRE value.

b) Unplug the float from the distribution board (x5, FLOAT-SW) and plug it into the conductivity cell's position (x7, COND). CAUTION Be sure to plug in correctly!

c) From debug screen 23 does the FPRE value go very high?

Yes — Two possibilities: 1) Concentrate is bad or not being pulled by the concentrate pumps; 2) Bad conductivity cell (see diagram, previous page).

No — Remains at previous value. Two possibilities: 1) *Bad sensor board cable; 2) Bad distribution board connection (check carefully for corrosion).

* The sensor cable can be checked for continuity. Note that you are checking the COND CELL connection and see CHECKING THE SENSOR BOARD CABLE (page 74).

## CO- 7.0.0 CHECK DEBUG CONDUCTIVITY VALUE

Go to RINSE and call up debug screen 23. After 5 minutes does FPRE= 4000 or less?

Yes — See CO- 7.0.1

No — See CO- 7.0.3

## CO- 7.0.1 PERFORM PRESSURE TEST

a) Place the machine into DIALYZE MODE. Select a flow rate of 500 ml/min, clear blood alarms and turn the blood pump rate knob clockwise.

b) Select a UF RATE of 1000 ml/hr and turn UF on (green UF on/off LED MUST be on solid and the UF RATE numeric display must NOT blink).

c) Allow TMP increase to about 260 and then turn UF off. Allow 30 seconds for stabilization.

d) After stabilization does TMP remain stable (within +/- 60 mmHg) for three minutes?

Yes — See CO- 7.0.2

No — See PRESSURE HOLDING TESTS FAILING (page 60).

## CO- 7.0.2 CHECK FOR INTERMITTENT FLOW ERROR

Call up debug screen 5 and watch FLWERR very carefully for 10 minutes. Does FLWERR ever go to "1" during this time interval?

Yes — An intermittent flow error is indicated. See F- 9.0.0 (page 10).

No — Check BALANCING CHAMBER VOLUME and calibrate *ACID and *BICARB PUMP VOLUMES and CONDUCTIVITY CELL per CALIBRATION PROCEDURES.

* While the pumps are drawing concentrate from the burette determine if each is taking CONSTANT volumes per stroke (in one direction ONLY). If not check the pump's springs, seals, and diaphragm).

## CO- 7.0.3 CHECK FOR 'SHORTED' CONDUCTIVITY CELL

a) Unplug the conductivity cell from the distribution board (position x7, COND) . Check, inside the distribution board, for bent or corroded male pins.

b) Plug the 34°C Fresenius test (temperature) dummy connector into the cell's position (x7, COND). CAUTION! Plug in correctly. From debug screen 23, FPRE =3000 or less?

Yes Replace the conductivity cell (see diagram, page 49).

No See CO- 7.0.4

## CO- 7.0.4 CHECK SENSOR BOARD CABLE

a) Turn the power off and unplug both ends of the 34-pin sensor board cable. The sensor board is the smallest board in the card cage (far right). The cable plugs into the top edge and runs into the distribution board.

b) Check for bent or corroded male pins at the sensor and distribution board connectors.

c) Leave the cable unplugged for now and turn the power on. From the SELECT PROGRAM screen push the SET button ONCE and then call up debug screen 19. Is ACON= 3000 or less?

Yes The sensor board cable is bad.

No Two possibilities: 1) Bad sensor board; 2) Bad distribution board

## CO- 8.0.0 CHECK BICARB DEBUG SIGNAL

The machine 'thinks' that the blue bicarb connector is plugged into it's port.

Call up debug screen 1. With the bicarb connector out of it's port does BICOUT = "1"

Yes Two possibilities; 1) Bad actuator board; 2) Bad functional board.

No See CO- 8.0.1

## CO- 8.0.1 CHECK THE BICARB REED SWITCH

Unplug the bicarb reed switch from distribution board position x12, BIC-SW. Is BICOUT "1" now?

Yes Replace the bicarb reed switch (see diagram, page 47).

No a) Check inside the distribution board for bent or corroded male pins.

b) Unplug the sensor cable from both ends and check the female and male connectors for corrosion.

c) Plug all cables back in and place the machine into dialyze mode. If the problem is still present there are two possibilities; 1) Bad actuator board; 2) Bad functional board.

# SECTION 6 - CONCENTRATE PUMP 'END OF STROKE' (EOS) ERRORS

## EOS- 1.0.0 DETERMINE THE EOS

Call up debug screen 5:

ACEERR = "1", the ACID pump 'side' is issuing an EOS error. See EOS- 2.0.0

BICERR = "1", the BICARB pump 'side' is issuing an EOS error. See EOS- 3.0.0

## EOS- 2.0.0 CHECK ACID PUMP

This procedure uses the bicarb pump (known good) to check the acid pump.

a) Switch the concentrate pump connectors at the distribution board (i.e. Turn the machine OFF then plug the bicarb pump into acid pump's position and visa-versa, see diagram below).

b) Call up debug screen 0 and wait 30 seconds. Are ACID and AACI within 5 units of each other?

Yes Replace the acid pump (or see 2008H ACID & BICARBONATE REPAIR PROCEDURE).

No See EOS- 4.0.0

## EOS- 3.0.0 CHECK BICARB PUMP

This procedure uses the acid pump (known good) to check the bicarb pump.

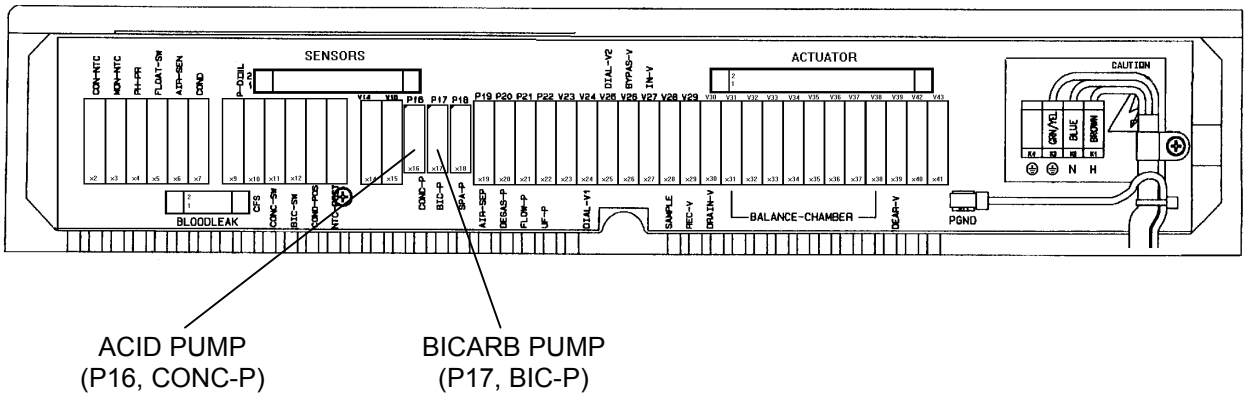
a) Switch the concentrate pump connectors at the distribution board (i.e. Turn the machine OFF then plug the acid pump into bicarb pump's position and visa-versa, see diagram below).

b) Call up debug screen 0 and wait 30 seconds. Are BIC and ABIC within 5 units of each other?

Yes Replace the bicarb pump (or see 2008H ACID & BICARBONATE REPAIR PROCEDURE).

No See EOS- 4.0.0

## DISTRIBUTION BOARD



## EOS- 4.0.0 CHECK CONCENTRATE PUMP CIRCUIT

Four possibilities: 1) [a]Bad actuator cable; 2) [b]Bad sensor board cable; 3) Bad actuator board; 4) Bad distribution board (check for corrosion).

[a] The actuator cable can be checked. Which 'side' is issuing the error?

| | |
|---|---|
| ACID | The actuator cable can be checked for continuity. Note that you are checking ACID PUMP connections and see CHECKING THE ACTUATOR BOARD CABLE (page 72). |
| BICARB | The actuator cable can be checked for continuity. Note that you are checking BICARB PUMP connections and see CHECKING THE ACTUATOR BOARD CABLE (page 72). |

[b] The sensor cable can be checked. Which 'side' is issuing the error?

| | |
|---|---|
| ACID | The sensor cable can be checked for continuity. Note that you are checking the ACID EOS connection and see CHECKING THE SENSOR BOARD CABLE (page 74). |
| BICARB | The sensor cable can be checked for continuity. Note that you are checking the BICARB EOS connection and see CHECKING THE SENSOR BOARD CABLE (page 74). |

## SECTION 7 - COND OFFSET REF OR COND OFFSET FAILURES

Perform these procedures ONLY if the machine is issuing "COND OFFSET REF" or "COND OFFSET FAILURE" messages upon power up.

NOTE: If you have changed the SENSOR or FUNCTIONAL board since the last COND CELL CALIBRATION these failures are normal. Perform COND CELL CALIBRATIONS.

### CR- 1.0.0 TROUBLESHOOTING OFFSET ERRORS

Attempt to calibrate CONDUCTIVITY CELL per CALIBRATION PROCEDURES. If unsuccessful there are four possibilities: 1) *Bad test board; 2) Bad sensor board; 3) Bad actuator board; 4) Bad functional board.

* NOTE: An alternative to swapping the test board is to remove IC 30 from the test board and run the machine without it. The machine runs ok without IC 30 but will fail tests.

# SECTION 8 - FILLING PROGRAM PROBLEMS

## FI- 1.0.0 CHECK FLOW ERRORS

Call up debug screen 5. If FLWERR = "1" a flow error is present. Do NOT troubleshoot FILLING PROGRAM PROBLEMS with flow errors present. If FLWERR = "0" proceed to FI- 1.0.1

## FI- 1.0.1 CHECK TEMP/COND

Return to the main DIALYSIS screen. Do NOT troubleshoot FILLING PROGRAM PROBLEMS unless COND and TEMP are normal and the BYPASS LED is off. If COND and TEMP are ok proceed to FI- 1.0.2.

## FI- 1.0.2 CHECK DEBUG 'FILACT'

a) Assure that the dialysate lines are in the shunt and the shunt door is closed.

b) With TMP less than 100 call up debug screen 7. Is FILACT = "1" or "0"?

"1" See FI- 1.0.4

"0" A FILLING PROGRAM is currently not present. See FI- 1.0.3

## FI- 1.0.3 FILLING PROGRAM CHECKS

Generally FILLING PROGRAMS are caused by air leaks. Perform both INDUCED POSITIVE PRESSURE TESTS (page 65) AND NEGATIVE PRESSURE TESTS (page 62) to locate a leak if:

- the message "10 FILL PROGRAMS IN 1 HR" is coming up on the screen
- FILLING PROGRAM is occurring ONLY at high TMP values

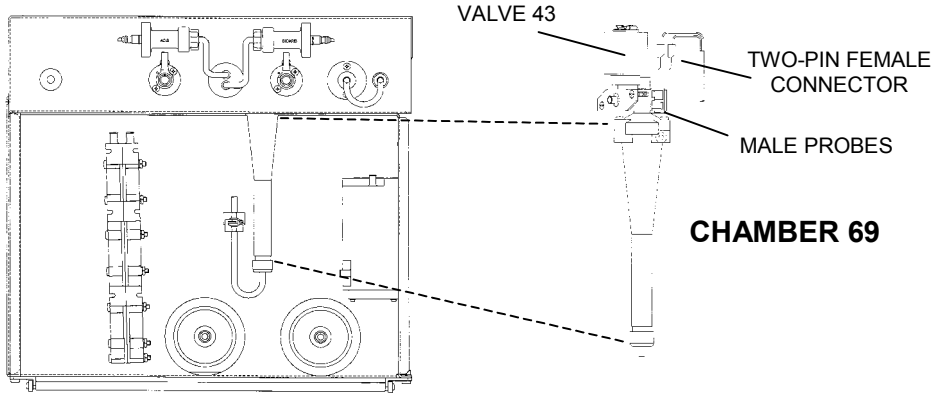
## FI- 1.0.4 CHECK AIR SENSOR

a) Assure that the two-pin female connector is plugged onto male probes at chamber 69 (see diagram below). Brown at the top probe, blue at the bottom. If ok proceed.

b) Unplug the female connector and connect both ends together. Wait 30 seconds. Does FILACT = "0"?

Yes See FI- 1.0.5

No See FI- 1.0.6




**HYDRAULICS, FRONT VIEW**

## FI- 1.0.5 CHECK CONNECTOR

Place the female connector back onto the probes (brown at top probe, blue at bottom) and wait 30 seconds. Does FILACT remain "0"?

Yes a) Check the two-pin wiring female connector and harness for bare wires. Replace if bare.

b) Check for a 'tight' connection between the female connector and the male probes.

No FILACT = "1". If conductivity is normal a problem is indicated with the male probes.

## FI- 1.0.6 CHECK AIR REMOVAL HARNESS

a) Unplug the air sensor connector from distribution board position x6, AIR-SEN. Check, inside the distribution board, for bent, broken or corroded male pins.

b) Place a jumper wire, between male pins 1 and 5 (top and bottom). CAUTION! Make sure that you put the jumper into the correct distribution board position. Does FILACT = "0"?

Yes The two-pin female connector is bad (open).

No See FI- 1.0.7

## FI- 1.0.7 CHECK SENSOR BOARD

a) Place the female connector back onto the probes (brown at top probe, blue at bottom).

b) Plug the air sensor connector back into the distribution board position x6, AIR-SEN.

CAUTION! Be careful to plug in correctly.

c) Turn the power off go to T&C by turning on dipswitch 7 on the functional board.

d) Swap in a sensor board and turn the power back on. Return to DIALYZE MODE.

e) Wait until conductivity comes up and call up debug screen 7. Is FILACT "1" or "0"?

"1" Two possibilities: 1) *Bad sensor board cable; 2) Bad functional board.

0" The previous sensor board is bad.

* The sensor cable can be checked for continuity. Note that you are checking the AIR SENSOR connection and see CHECKING THE SENSOR BOARD CABLE (page 74).

# SECTION 9 - TMP PROBLEMS

## TM- 1.0.0 CHECK FOR FLOW ERROR

Call up debug screen 5. If FLWERR = "1" a flow error is present. Do NOT troubleshoot TMP PROBLEMS with flow errors present. If FLWERR = "0" proceed to TM- 1.0.1

## TM- 1.0.1 CHECK FOR FILLING PROGRAM

Call up debug screen 7. If FILACT = "1" a FILLING PROGRAM is present. Do NOT troubleshoot TMP PROBLEMS until FILLING PROGRAM is clear. If FILACT = "0" proceed to TM- 1.0.2

## TM- 1.0.2 CHECK TMP FAULT

Push SET to return to the main screen. Is TMP 'pegged' at either +60 or 520 mmHg?

Yes See TM- 1.0.3

No Perform pressure holding tests (negative flow on/positive flow off). If both pass a TMP problem is not indicated.

## TM- 1.0.3 ADJUST TMP

a) Push RESET. The message "ADJUST TMP?" comes up on the screen.

b) Push and hold RESET until "ADJUST TMP" is up. Does TMP move from it's previous value?

Yes See TM- 1.0.4

No See TM- 2.0.0

## TM- 1.0.4 CHECK FOR TMP PEGGING

Does TMP return quickly (within 30 seconds) to it's previous 'pegged' value?

Yes See TM- 1.0.5

No Perform pressure holding tests (negative flow on/positive flow off). If both pass a TMP problem is not indicated.

## TM- 1.0.5 PERFORM PRESSURE TEST

This procedure will determine if a problem is located in the balancing chambers.

a) Adjust TMP from it's 'pegged' value, clear blood alarms, and turn the blood pump rate knob clockwise.

b) Select a UF RATE of 1000 ml/hr and turn UF on (green UF on/off LED MUST be on solid and the UF RATE numeric display must not blink).

c) Allow TMP increase to about 260 and then turn UF off.

d) Turn flow off and allow 30 seconds for stabilization. Does TMP remain stable (within +/- 40 mmHg) for three minutes?

Yes See TM- 1.0.6

No Four possibilities:

1) Hydraulic leak. Perform both INDUCED POSITIVE PRESSURE TESTS (page 65) AND NEGATIVE PRESSURE TESTS (page 62) to locate a possible leak;

2) Leaking valve. Perform VALVE LEAK TEST from SERVICE/DIAGNOSTICS;

3) Dialysate pressure out of calibration (see CALIBRATION PROCEDURES, section 2.3);

4) Bad dialysate pressure transducer #9 (see diagram A, page 5).

**TM- 1.0.6 PERFORM VALVE LEAK TESTS**

A problem is indicated in the balancing chambers.

a) Place the machine into SERVICE/DIAGNOSTICS.

b) Select #11 VALVE LEAK TEST and wait until the "READY" message appears.

c) Push SET twice to start the tests. Is a balancing chamber valve (valves 31 through 38) leak indicated?

Yes Unplug the leaking valve from the distribution board (for example, valve 36 plugs into position V36) and measure for voltage, inside the distribution board, between male pins 1 and 5 (top and bottom). If one vdc or greater replace the actuator board otherwise replace the indicated leaking valve.

No See MANUAL BALANCING CHAMBER VALVE LEAK TESTS (page 76) if a leak is not found perform TESTING FOR A LEAKING BALANCING CHAMBER DIAPHRAGM (page 79).

**TM- 2.0.0 CHECK SENSOR BOARD DEBUG VALUE (PDIA)**

a) Turn the flow off, remove the dialysate lines from the shunt and drop them into a bucket of water on the floor.

b) Close the shunt door (important).

c) Call up debug screen 9. Is PDIA between 4.0 and 7.0 vdc?

Yes See TM- 2.0.3

No See TM- 2.0.1

**TM- 2.0.1 CHECK ACTUATOR BOARD DEBUG VALUE (ADIA)**

Call up debug screen 11. Is ADIA between 3.0 and 6.0 vdc?

Yes Replace the sensor board.

No See TM- 2.0.2

## TM- 2.0.2 CHECK DIALYSATE PRESSURE TRANSDUCER

This procedure tests the dialysate pressure transducer using the known good CFS transducer.

a) Unplug the CFS and dialysate pressure transducers from their respective distribution board positions (x10, CFS)(x9, P-DIAL).

b) Plug the CFS connector into position x9, P-DIAL. CAUTION! Be sure to plug in correctly.

c) From debug screen 11. Does ADIA read between 3.0 and 6.0 vdc?

Yes Return the transducers to their correct distribution board positions (important). Calibrate DIALYSATE PRESSURE per CALIBRATION PROCEDURES, section 2.3. If not successful replace the dialysate pressure transducer #9 (see diagram A, page 5) and calibrate.

No See TM- 2.0.4

## TM- 2.0.3 CHECK TMP

Push SET to return to the main screen. Is TMP between 0 and 100 mmHg?

Yes Return the lines to the shunt door and perform pressure holding tests (negative flow on/positive flow off). If both pass a problem is not indicated.

No Calibrate DIALYSATE PRESSURE per CALIBRATION PROCEDURES, section 2.3. If not successful replace the dialysate pressure transducer #9 (see diagram A, page 5) and calibrate.

## TM- 2.0.4 CHECK TEST BOARD

a) Leave the CFS transducer plugged into position x9, P-DIAL for now.

b) Turn the power off and swap in a new test board. NOTE An alternative is to remove IC 4 from the test board. The machine runs fine without IC 4 but will fail tests.

c) Turn the power on and enter DIALYZE mode. From debug screen 11, is ADIA between 3.0 and 7.0 vdc?

Yes The previous test board (or IC 4) is bad. CAUTION! Make sure to plug the transducers back into their correct distribution board positions.

No See TM- 2.0.5

## TM- 2.0.5 CHECK DIALYSATE PRESSURE CIRCUIT

a) IMPORTANT return the transducers to their correct distribution board positions.

b) Four possibilities: 1) *Bad sensor board cable; 2) Bad sensor board; 3) Bad actuator board; 4) Bad functional board.

* The sensor cable can be checked for continuity. Note that you are checking DIALYSATE TRANSDUCER connections and see CHECKING THE SENSOR BOARD CABLE (page 74).

# SECTION 10 - PRESSURE HOLDING TESTS FAILING

NOTE: These procedures assume that DIALYSATE PRESSURE has been calibrated accurately.

## PH- 1.0.0 CHECK LOADING PRESSURE

Insert the loading pressure gauge tightly into the ACID/ACETATE port. This pressure should be between 18 and 20 psi. Calibrate as necessary and run PRESSURE HOLDING TESTS again. If loading pressure is ok proceed to PH- 1.0.1

## PH- 1.0.1 CHECK FOR LEAKS

Look for obvious fluid leaks inside the hydraulic compartment and at the external dialysate lines (especially the hansen connectors). If a leak is not seen proceed to PH- 1.0.2

## PH- 1.0.2 CHECK DEAERATION

a) Turn the flow off and wait 60 seconds or until you hear the deaeration pump turn off.

b) Tee a negative pressure gauge between the clear (INPUT) line and the deaeration pump's input nozzle (see diagram, page 63).

c) Turn flow on at a 500 flow rate. Deaeration pressure -24 inHg to -25 inHg?

Yes See PH- 1.0.3

No See DEAERATION PROBLEMS (page 66).

## PH- 1.0.3 PERFORM INDUCED POSITIVE PRESSURE TESTS

Read this entire step before proceeding. Run INDUCED POSITIVE PRESSURE TESTS (page 65) to locate a possible fluid leak. If a leak not seen proceed to PH- 1.0.4

## PH- 1.0.4 PERFORM TMP PUMP UP

a) Clear ALL blood alarm messages and turn the blood pump rate above 90 mL/min.

b) Select a UF RATE of 1000 ml/hr and turn UF on (green UF on/off LED MUST be on solid and the UF RATE numeric display MUST NOT blink). Does TMP increase to 280 or greater?

Yes Run NEGATIVE PRESSURE TESTS (page 62) to locate a possible air leak. If a leak is not found see PH- 1.0.6

No See PH- 1.0.5

## PH- 1.0.5 CHECK UF PUMP

CLEAR all blood alarms. With UF ON determine if the UF pump is stroking by checking compressions of the large external spring (see diagram, page 62). Is the pump stroking?

Yes See PH- 1.0.6

No See UF PUMP PROBLEMS (page 67).

## PH- 1.0.6 VALVE LEAK TESTS

a) Place the machine into SERVICE/DIAGNOSTICS. Select #11 VALVE LEAK TEST and wait until the "READY" message appears.

b) Push SET TWICE to start the tests. Valve leak indicated?

Yes Run VALVE LEAK TEST AGAIN on the bad valve to confirm. If it fails again see PH- 1.0.7

No Return to DIALYZE MODE and run PRESSURE HOLDING TESTS (negative flow on/positive flow off). If still failing see PH- 1.0.9

## PH- 1.0.7 DETERMINE THE LEAK

"VALVE 44 FAILURE": Perform INDUCED POSITIVE PRESSURE TESTS (page 65) and check for a fluid leak especially in the vicinity of air removal chamber #69 (see diagram, page 65).

ONE VALVE LEAKING: See PH- 1.0.8

VALVES 29/30 LEAKING: May also indicate a leaking heat exchanger. TIGHTLY clamp the tubing at the input nozzles of valve 30 AND 29 (see diagram, page 62) and run VALVE LEAK TESTS again. If the test fails the heat exchanger is leaking (see diagram, page 65). If the test passes remove the clamp from valve 30 **only** and run VALVE LEAK TESTS once again. If the test fails valve 30 may be leaking (see PH- 1.0.8). If the test passes valve 29 may be leaking (see PH- 1.0.8).

MORE THAN ONE VALVE LEAKING: a) Check UF pump check valves #63 and #64 (see diagram, page 67); b) Perform both INDUCED POSITIVE PRESSURE TESTS (page 65) **AND** NEGATIVE PRESSURE TESTS (page 62) to locate a possible fluid leak; c) Calibrate DIALYSATE PRESSURE per CALIBRATION PROCEDURES, section 2.3.

## PH- 1.0.8 CHECK FOR SHORTED ACTUATOR BOARD VALVE DRIVER

Leave the machine in DIAGNOSTICS with the failure message on the screen. Unplug the indicated leaking valve from the distribution board (for example, valve 33 plugs into position V33) and measure dc voltage between **male** pins 1 and 5 (top and bottom) inside the distribution board. One vdc (or greater) replace the actuator board otherwise replace the leaking valve.

## PH- 1.0.9 MANUAL PRESSURE TEST

a) Select a flow rate of 500 ml/min, clear all blood alarms and turn the blood pump rate knob clockwise.

b) Select a UF RATE of 1000 ml/hr and turn UF on (green UF on/off LED MUST be on solid and the UF RATE numeric display MUST NOT blink).

c) Allow TMP increase to about 260 and then turn UF off. Turn FLOW OFF and allow 30 seconds for stabilization. Does TMP remains stable (within +/- 40 mmHg) for three minutes?

Yes A leak in the balancing chamber is indicated. Perform MANUAL BALANCING CHAMBER VALVE LEAK TESTS (page 76). If a leaking valve is not found perform TESTING FOR A LEAKING BALANCING CHAMBER DIAPHRAGM (page 79).

No Perform both INDUCED POSITIVE PRESSURE TESTS (page 65) AND NEGATIVE PRESSURE TESTS (page 62) to locate a possible fluid leak.

# SECTION 11 - NEGATIVE PRESSURE TESTS

These tests use negative pressure to locate a hydraulic leak.

I. It is assumed that deaeration pressure has been previously checked to -24 inHg to -25 inHg.

II. Using a flashlight is helpful. All checks are done by looking through clear hydraulic tubing.

## A- 1.0.0 CHECK FOR AIR LEAK

a) Assure that the dialysate lines are in the shunt and the door is closed.

b) Clear ALL dialysate and blood alarms and turn the blood pump rate knob fully clockwise.

c) Select a UF RATE of about 1000 ml/hr and turn the UF on (the green UF on/off LED MUST be on solid and the UF RATE numeric display MUST NOT blink).

d) Allow the TMP to increase to about 260 and turn the UF off.

NOTE: A TMP of 300 (or greater) should be maintained to run these tests. Air bubbles are larger and much easier to see at higher TMP.

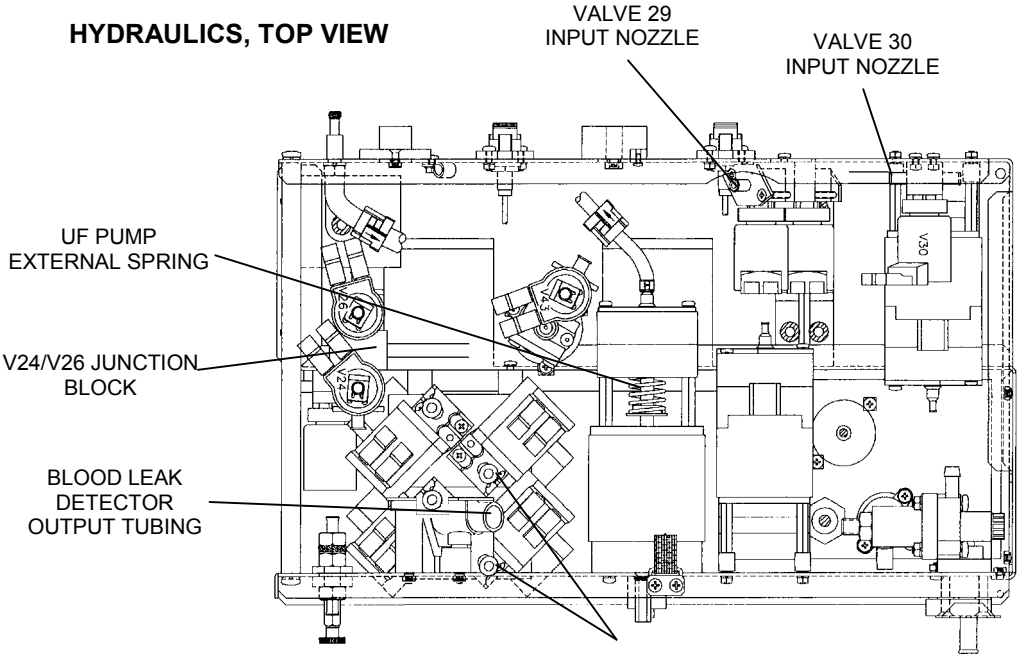
e) Look through the clear tubing at the OUTPUT of the blood leak detector tubing (see diagram below), are *large air bubbles seen?

Yes See A- 1.0.1

No An air leak is not obvious using this test. Return to previous procedures and proceed accordingly

* Smaller air bubbles may be 'normal'. Check another machine (that is passing pressure holding tests) to determine what 'normal' looks like.

**HYDRAULICS, TOP VIEW**



## A- 1.0.1 LOCATING THE LEAK

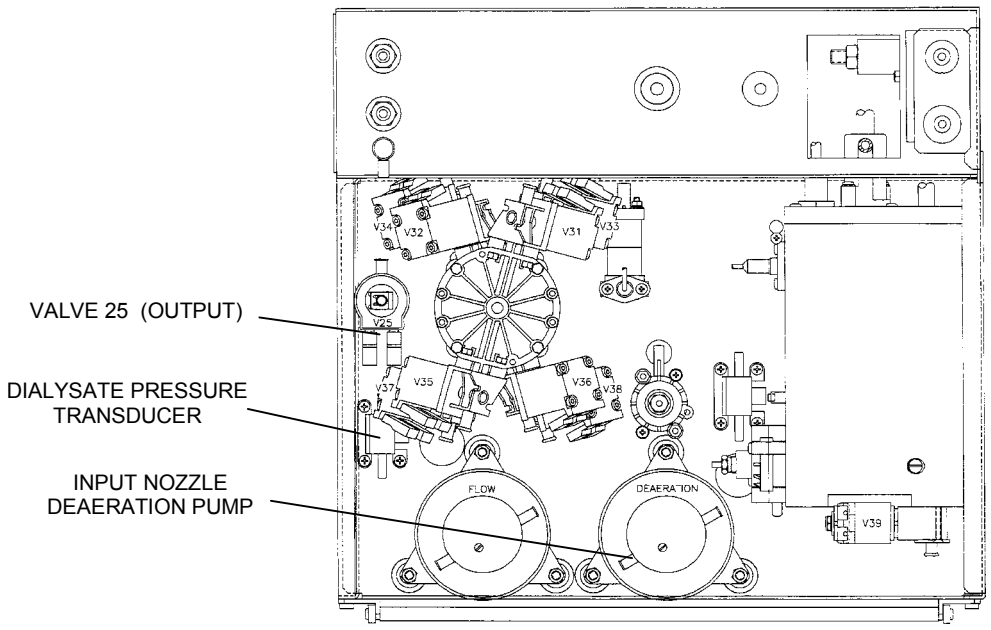
Check for air bubbles at the following locations in the following order:

**NOTE:** TMP must be maintained at about 300 for these tests.

1. OUTPUT tubing at valve 25 (see diagram below). If air is not seen check the tubing connections at the blood leak detector and dialysate pressure transducer.
2. INPUT tubing at the external dialysate line filter (73) (see diagram A, page 5). If air is not seen check the o-ring inside the filter housing.
3. INPUT tubing at the venous (blue) hansen connector. If air is not seen replace the hansen connector o-rings
4. INPUT tubing at the external flow indicator (75) (see diagram A, page 5). If air is not seen check the o-rings inside the indicator.
5. INPUT tubing at the valve 24/26 junction block (see diagram, previous page). If air is not seen check the block for bad o-rings or cracks.
6. OUTPUT tubing from balancing chamber valves 31 and 33 (see diagram, previous page). If air is not seen check the tubing connections at the conductivity cell #7.
7. Is air coming from ONE or BOTH valves 31 and 33?

   One Check the connection (and o-ring) between the leaking valve and the balancing chamber.

   Both See A- 1.0.2




**HYDRAULICS, REAR VIEW**

## A- 1.0.2 CHECK BICARB INLET SYSTEM

a) Check the clear bicarb inlet line for air. If air is seen check for a loose connection or bad o-rings at the bicarb connector.

b) Plug the bicarbonate connector back into it's port. After a few minutes check at balancing chamber valves 31 and 33. Is air still present?

Yes
a) Calibrate DEAERATION PRESSURE by first decreasing the DAC value until pressure is below -18 inHg and then increasing it SLOWLY until -24 inHg is obtained.

b) Perform both the INDUCED POSITIVE PRESSURE TESTS (page 65) AND NEGATIVE PRESSURE TESTS (page 62) to locate a possible leak (especially at balancing chamber valves 31 and 33).

No
Check the bicarb pump (o-rings), the injection site, and the mixing chamber #82 for an air leak.

## SECTION 12 - INDUCED POSITIVE PRESSURE TESTS

These tests use positive pressure to locate a hydraulic leak.

NOTE: These tests must be done from DIALYZE MODE.

a) At the top of the air removal chamber #69 is valve 43 and two male probes (see diagram below).

b) Unplug the two-pin female connector from each probe and place them such that they cannot come into contact with each other. A FILLING PROGRAM should be now be present (debug screen 7, FILACT = "1").

c) Clamp the clear tubing from valve 43's output nozzle. During FILLING PROGRAM the only path to drain is through valve 43. By clamping valve 43 this path is removed and the secondary hydraulic side is pressurized to loading pressure (+19 ± 1 psi).

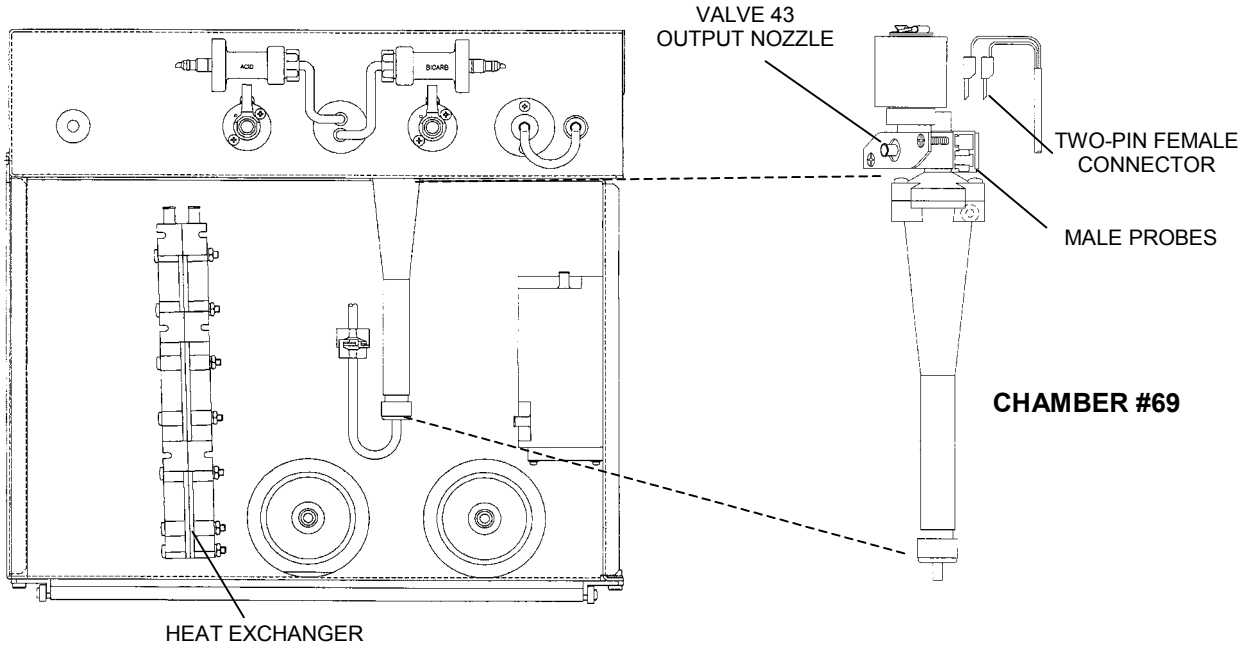
d) A flow error should become present (debug screen 5, FLWERR = 1). Push the SET key. TMP should = +60.

e) Remove the UF sample tube from the front of the machine and check for fluid leaks indicative of a bad UF pump output spring AND check valve #63.

f) Wait for SEVERAL minutes and then CAREFULLY search for fluid leaks. Look ESPECIALLY in the area of air removal chamber #69, flow pump tubing (input and output) and the flow pump regulator #78.

g) If a leak is not seen return the female connectors to the air removal chamber probes, unclamp valve 43, and return to previous procedures.

### HYDRAULICS, FRONT VIEW



# SECTION 13 - DEAERATION PROBLEMS

## D- 1.0.0 CHECK DEAERATION SYSTEM

a) Turn flow off and call up debug screen 17. Wait until DEAP = 255 and check the deaeration pump's motor shaft (diagram on page 6). If still rotating replace the actuator board (bad driver), otherwise proceed to part b.

b) Attempt DEAERATION CALIBRATION per procedure. If unsuccessful proceed to part c.

c) Clamp the solid tubing between valve 39 and the hydroblock (see diagram below) and attempt DEAERATION CALIBRATION again. Calibrate properly?

Yes See D- 1.0.2

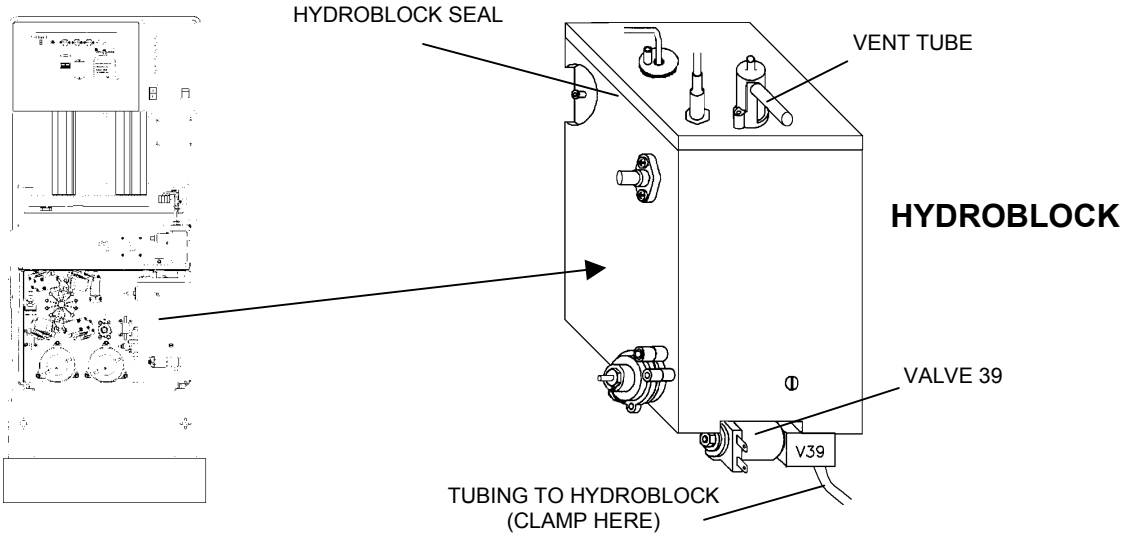
No Replace the deaeration pump head and attempt DEAERATION CALIBRATION. If not successful see D- 1.0.3 (the previous pump head is probably good).

## D- 1.0.2 CHECK ACTUATOR BOARD

Remove the clamp from valve 39. Unplug valve 39 from the distribution board (V39, DEAR-V). Deaeration pressure return to good?

Yes Replace the actuator board.

No Replace valve 39.




## D- 1.0.3 CHECK HYDROBLOCK

a) Turn the flow off and unplug the float from the distribution board (x5, FLOAT-SW). Place a jumper wire, inside the distribution board, between male pins 1 and 3 (top and middle). Water should eventually overflow from the vent tube.

b) Clamp the vent tube to pressurize the hydroblock to inlet water pressure (19 ± 1 psi) and look for a fluid leak at the top seal of the hydroblock (see HYDROBLOCK diagram above). Is a leak seen?

Yes Try tightening the screws that mounts the hydroblock cover to the hydroblock. If the leak continues replace the hydrobock seal (part # 565642).

No Two possibilities: 1) Bad actuator board; 2) Bad deaeration pump motor

# SECTION 14 - UF PUMP PROBLEMS

## UF- 1.0.0 CHECK DEBUG UFPULS

With UF OFF (important) call up debug screen 1. Is UFPULS = "1"?

Yes See UF- 2.0.0

No See UF- 1.0.1

## UF- 1.0.1 CHECK UF PUMP

a) Place the dialysate lines into a bucket of (conductive) water.

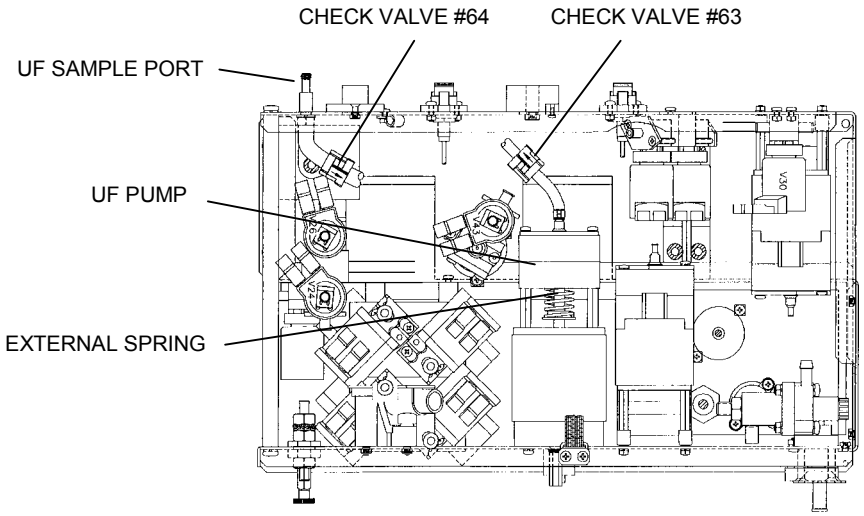
b) Clear all blood alarms and turn the blood pump rate knob fully clockwise.

c) Select a UF RATE of 1000 ml/hr and turn UF on (IMPORTANT the green UF on/off LED MUST remain on solid and the UF RATE numeric display MUST NOT blink).

d) Determine if the UF pump is stroking by watching for compressions of the large external spring (see diagram below). Is the UF pump stroking?

Yes See UF- 1.0.3

No Turn UF off and see UF- 1.0.2




**HYDRAULICS, TOP VIEW**

## UF- 1.0.2 CHECK ACTUATOR BOARD

a) Remove the cover from the UF pump's distribution board connector (P22, UF-P) and then plug the connector back in. CAUTION Be careful to plug in correctly!

b) Clamp meter leads between pins 1 and 5 (top and bottom, where the wires are attached).

c) Clear all alarms and turn UF on (green UF on/off LED MUST be on solid and the UF RATE numeric display MUST NOT blink). UF rate set to 1000 ml/hr.

d) Voltage to the connector should 'pulse' from between 26 and 22 vdc to less than 2 vdc. Is this ok?

Yes Replace the UF pump.

No Replace the actuator board.

**UF- 1.0.3 CHECK UF OUTPUT**

With UF on, remove the UF output tube from the sample port (see diagram, previous page). Are there 'strong' output strokes from the tube?

Yes See UF- 1.0.4

No a) Make sure check valve #63 is oriented properly (see diagram, previous page).

b) Check the UF pump for broken springs, bad o-rings, or a bad diaphragm.

**UF- 1.0.4 CHECK TMP PUMP UP**

a) Turn UF off and place the dialysate lines back into the shunt.

b) Clear all blood alarms and turn UF on. Does TMP (main screen) increase to 280 or greater?

Yes Make sure check valve #64 is oriented properly (see diagram, previous page).

No See UF- 1.0.5

**UF- 1.0.5 CHECK DIALYSATE PRESSURE**

a) Turn UF off and tee a three-way connector into the dialysate lines with one leg going to an external pressure meter.

b) Clear all blood alarms and turn UF on. Does meter pressure increase to greater than -260 mmHg?

Yes Calibrate DIALYSATE PRESSURE per CALIBRATION PROCEDURES, section 2.3.

No Perform both NEGATIVE PRESSURE TESTS (page 62) AND INDUCED POSITIVE PRESSURE TESTS (page 65) to locate a hydraulic leak.

**UF- 2.0.0 CHECK UF PUMP SOLENOID RESISTANCE**

a) Unplug the UF pump from distribution board position P22, UF-P.

b) Remove the plastic cover and measure resistance between the two soldered wires inside the female connector. Between 8 and 12 ohms?

Yes Two possibilities: 1) *Bad actuator board cable; 2) Bad actuator board.

No Replace the UF pump.

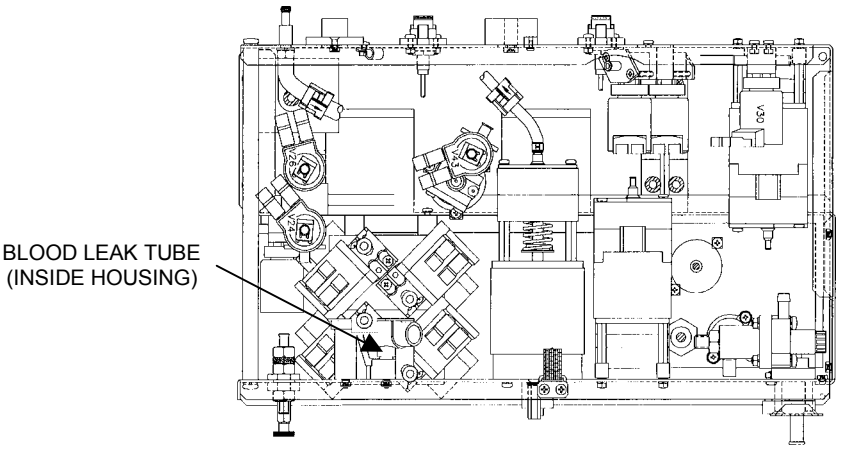
* The actuator cable can be checked for continuity. Note that you are checking UF PUMP connections and see CHECKING THE ACTUATOR BOARD CABLE (page 72).

# SECTION 15 - BLOOD LEAK PROBLEMS

NOTE: Do not proceed unless the BYPASS LED is off (i.e. out of bypass).

## BL- 1.0.0 CHECK DIMNESS

Call up debug screen 9. If DIMN is greater than 5.5 or less than 4.0 vdc check the blood leak detector's glass tube for calcium (the tube appears 'cloudy') and air bubbles. If calcium is seen run BLEACH/RINSE. If air is seen perform NEGATIVE PRESSURE TESTS and/or INDUCED POSITIVE PRESSURE TESTS to locate the leak.




**HYDRAULICS, TOP VIEW**

## BL- 2.0.0 CHECK LEAK

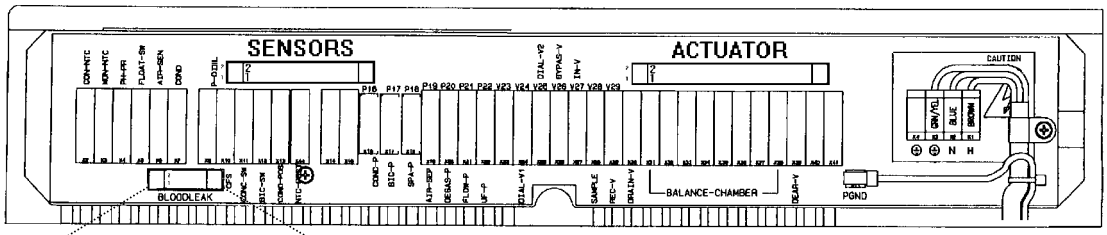
From debug screen 9, if LEAK is greater than 5.2 or less than 4.5 vdc attempt BLOOD LEAK calibrations (DETECTOR and DIMNESS, sections 2.6.1 and 2.6.2, CALIBRATION PROCEDURES).

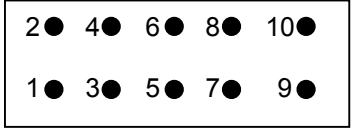
## BL- 3.0.0 CHECK BLOOD LEAK SIGNALS

a) Turn the power off and place a ground lead at TEST connector SGND (see CARD CAGE diagram, page 71).

b) Unplug the blood leak detector from the distribution board's x8 connector. Measure dc voltages at the male pins specified in the BLOOD LEAK SIGNALS table (page 70). Follow the instruction given.

**DISTRIBUTION BOARD**




**X8 CONNECTOR**

**BLOOD LEAK SIGNALS (at x8 connector)**

| PIN | GOOD (vdc) | BAD |
|---|---|---|
| 3 (+12V) | 11.4 to 12.6, measure at pin 6 | Sensor board cable |
| 6 (TEST) | Between 0 and 1, measure at pin 7 | [1]Sensor board cable or test board (IC 44) |
| 7 (LEAK) | See **DAC PROCEDURE:**<br>**a)** With DAC set at " 255" voltage = between 9.5 and 10.0<br>**b)** With DAC set at "0" voltage = between 0 and 0.5, measure at pin 9 | [2]Sensor cable or sensor board (IC 6) |
| 9 (DIMN) | See **DAC PROCEDURE:**<br>**a)** With DAC set at " 255" voltage = between 9.5 and 10.0<br>**b)** With DAC set at "0" voltage = between 0 and 0.5, see BL- 4.0.0 | [3]Sensor cable or sensor board (IC 6) |

[1] The sensor cable can be checked for continuity. Note that you are checking the BLOOD LEAK **TEST** connection and see CHECKING THE SENSOR BOARD CABLE (page 74)

[2] The sensor cable can be checked for continuity. Note that you are checking the BLOOD LEAK **SENSOR** connection and see CHECKING THE SENSOR BOARD CABLE (page 74)

[3] The sensor cable can be checked for continuity. Note that you are checking the BLOOD LEAK **DIMNESS** connection and see CHECKING THE SENSOR BOARD CABLE (page 74)

**DAC PROCEDURE**

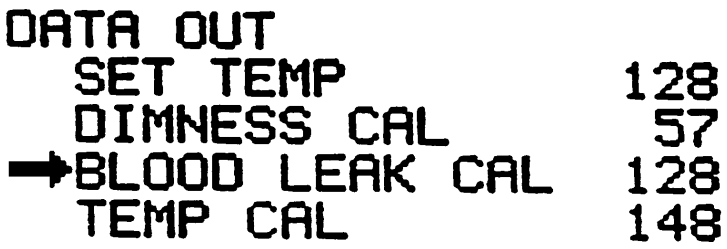
Place the machine into SERVICE mode and enter DIAGNOSTICS/7, OUTPUT TO D TO A. There are two parts to this procedure:

**PART I** (While measuring voltage at connector x8, pin 7).

a) Select and change the BLOOD LEAK CAL value to "255".

b) Move the pointer in front of BLOOD LEAK CAL (as shown) and **PRESS** the SET button.

**WARNING!** Not pushing SET results in incorrect voltages.



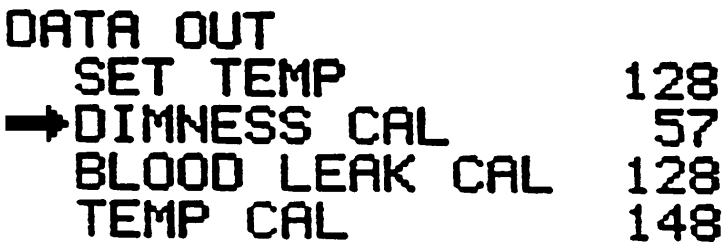

c) Repeat procedure, this time setting BLOOD LEAK CAL to "0". Move the pointer in front and **PRESS** the SET button.

**WARNING!** Not pushing SET results in incorrect voltages.

**PART II** (While measuring voltage at connector x8, pin 9).

a) Select and change the DIMNESS CAL value to "255".

b) Move the pointer in front of DIMNESS CAL (as shown) and **PRESS** the SET button. **WARNING!** Not pushing SET results in incorrect voltages.




c) Repeat procedure, this time setting DIMNESS CAL to "0". Move the pointer in front and **PRESS** the SET button. **WARNING!** Not pushing SET results in incorrect voltages.

## BL- 4.0.0 CHECK SENSOR BOARD BLOOD LEAK OUTPUT

a) Turn the power off and take the machine out of SERVICE mode.

b) Plug the blood leak detector back into the distribution board.

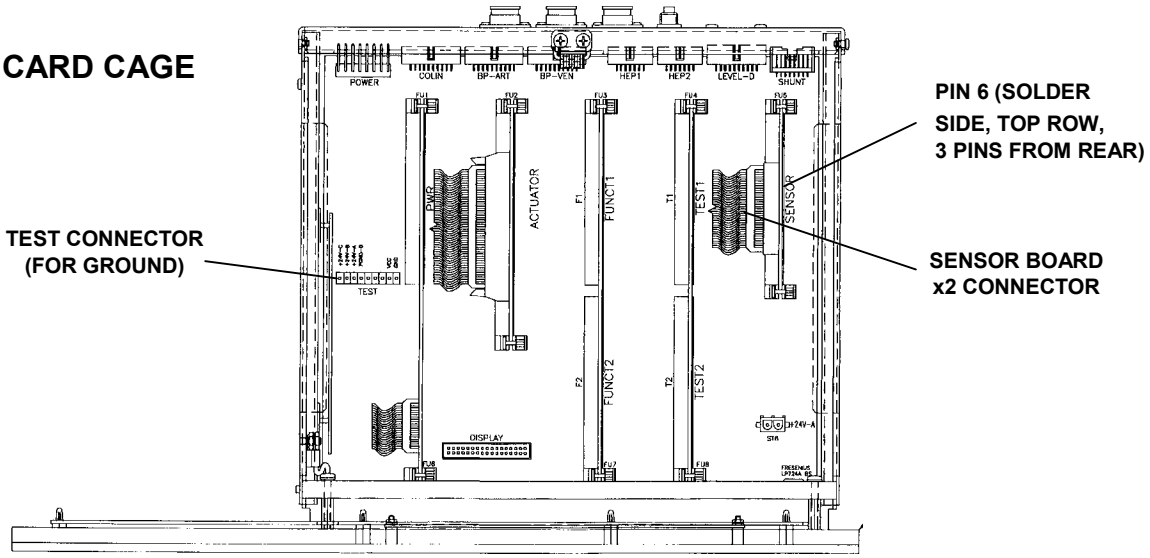
c) Turn the power back on and return to DIALYZE mode.

d) Measure voltage, from the back (solder) side of the sensor board's, x2 connector at pin 6 (see diagram below). Between 4.5 and 5.2 vdc?

Yes Currently a problem is NOT indicated. Possible intermittent blood leak sensor.

No Two possibilities: 1) [4]Sensor board cable; 2) Bad blood leak detector.

[4] The sensor cable can be checked for continuity. Note that you are checking the BLOOD LEAK **OUTPUT** connection and see CHECKING THE SENSOR BOARD CABLE (page 74)



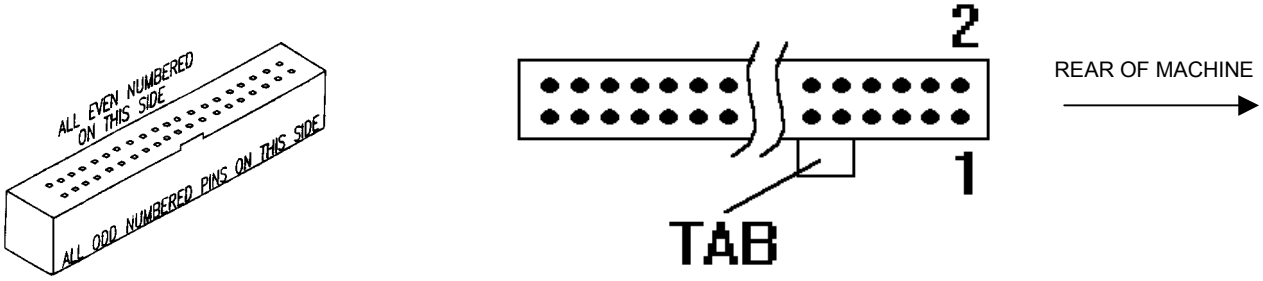
## SECTION 16 - CHECKING THE ACTUATOR BOARD CABLE

a) Turn the POWER OFF and unplug the actuator board cable from the distribution board (ACTUATOR CONNECTOR).

b) Using a flashlight, check inside the male connector for bent or broken pins. Check also for signs of corrosion.

c) Check the female cable end for signs of corrosion. The cable ends are arranged in two rows, even in one row, odd in the other. The TAB identifies the 'odd' row.

**FEMALE CONNECTOR**

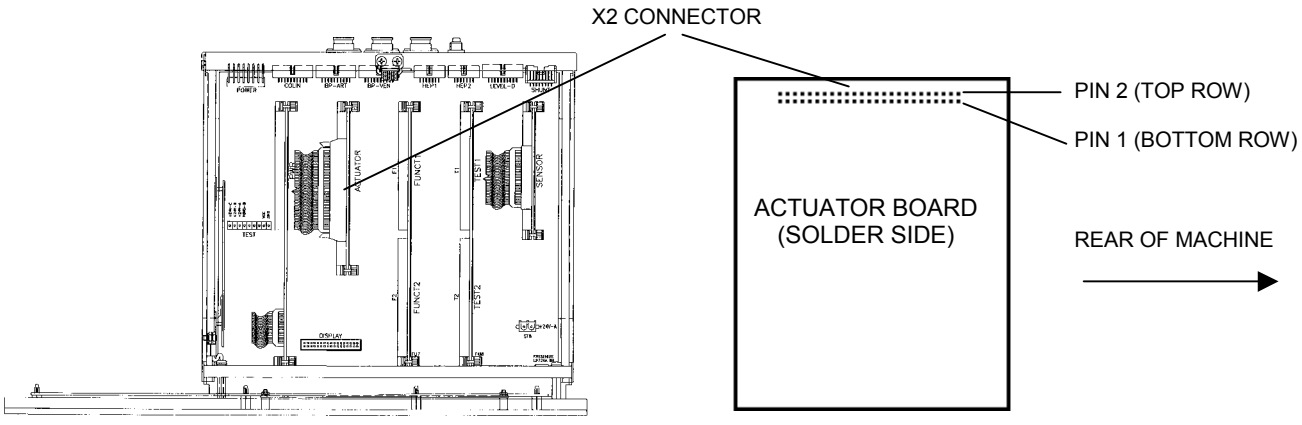



d) Inside the card cage the cable terminates at connector X2 (actuator board). The solder (back) side pins of this connector are arranged in two rows. Unplug the cable from the connector and check inside the male connector for corrosion or bent pins. Replace cable when check is complete.

IMPORTANT NOTE: A regular meter probe does not penetrate deep enough to make a connection. Do NOT use a paper clip or you may damage the connector.

e) Clip one meter lead to a metal object small enough to fit *loosely* into the holes of the connector. This will be used as our 'probe'. Count to the indicated female pin (see table, next page) and stick the 'probe' into it.

f) Place the second meter lead on the matching numbered pin (see table, next page) on the solder side of the connector. A good connection will measure 10Ω or less.




**CARD CAGE**

## ACTUATOR BOARD, P2 CABLE, PIN IDENTIFICATION (PUMPS)

| PUMP | P2 PIN # | P2 LOCATION |
|---|---|---|
| DEAERATION PUMP (1 of 2) | 15 | Bottom row, 8 pins from rear |
| DEAERATION PUMP (2 of 2) | 16 | Top row, 8 pins from rear |
| FLOW PUMP (1 of 2) | 19 | Bottom row, 10 pins from rear |
| FLOW PUMP (2 of 2) | 20 | Top row, 10 pins from rear |
| ACID PUMP (1 of 4) | 1 | Bottom row, first pin from rear |
| ACID PUMP (2 of 4) | 2 | Top row, first pin from rear |
| ACID PUMP (3 of 4) | 3 | Bottom row, 2 pins from rear |
| ACID PUMP (4 of 4) | 4 | Top row, 2 pins from rear |
| BICARB PUMP (1 of 4) | 5 | Bottom row, 3 pins rom rear |
| BICARB PUMP (2 of 4) | 6 | Top row, 3 pins from rear |
| BICARB PUMP (3 of 4) | 7 | Bottom row, 4 pins from rear |
| BICARB PUMP (4 of 4) | 8 | Top row, 4 pins from rear |
| UF PUMP (1 of 4) | 23 | Bottom row, 12 pins from rear |
| UF PUMP (2 of 4) | 24 | Top row, 12 pins from rear |
| UF PUMP (3 of 4) | 25 | Bottom row, 13 pins from rear |
| UF PUMP (4 of 4) | 26 | Top row, 13 pins from rear |

## ACTUATOR BOARD, P2 CABLE, PIN IDENTIFICATION (VALVES)

| VALVE | P2 PIN# | P2 LOCATION |
|---|---|---|
| 24 | 29 | Bottom row, 11 pins from front |
| 41 (27) | 32 | Top row, 10 pins from front |
| 43 | 46 | Top row, 3 pins from front |
| 39 | 44 | Top row, 4 pins from front |
| 29 | 34 | Top row, 9 pins from front |

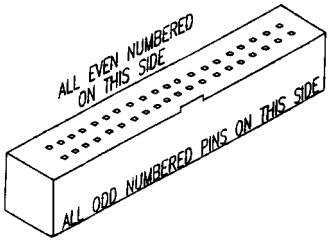
## SECTION 17 - CHECKING THE SENSOR BOARD CABLE

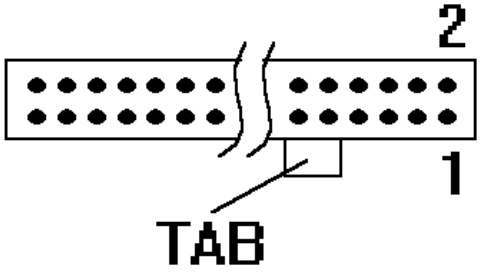
a) Turn the POWER OFF and unplug the smaller sensor board cable from the distribution board (SENSORS CONNECTOR).

b) Using a flashlight, check inside the male connector for bent or broken pins. Check also for signs of corrosion.

c) Check the female cable end for signs of corrosion. The cable ends are arranged in two rows, even in one row, odd in the other. The TAB identifies the 'odd' row.

### FEMALE CONNECTOR



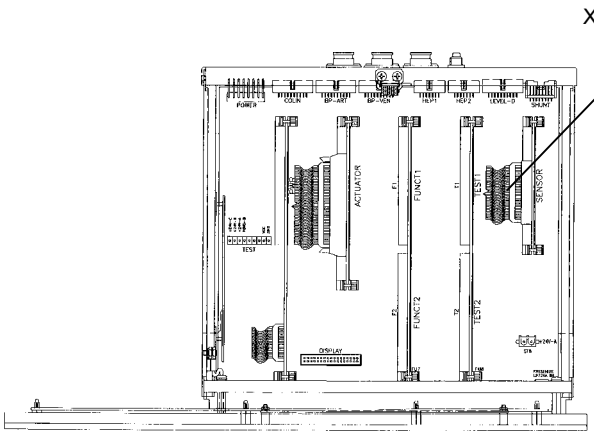

REAR OF MACHINE →

d) Inside the card cage the cable terminates at connector X2 (sensor board). The solder (back) side pins of this connector are arranged in two rows. Unplug the cable from the connector and check inside the male connector for corrosion or bent pins. Replace cable when check is complete.

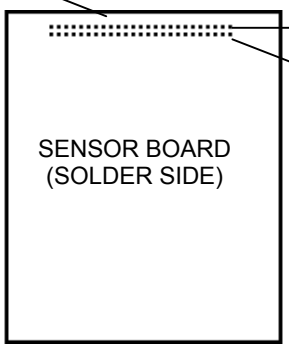
IMPORTANT NOTE: A regular meter probe does not penetrate deep enough to make a connection. Do NOT use a paper clip or you may damage the connector.

e) Clip one meter lead to a metal object small enough to fit *loosely* into the holes of the connector. This will be used as our 'probe'. Count to the indicated female pin (see table, next page) and stick the 'probe' into it.

f) Place the second meter lead on the matching numbered pin (see table, next page) on the solder side of the connector. A good connection will measure 10 Ω or less.




CARD CAGE




PIN 2 (TOP ROW)

PIN 1 (BOTTOM ROW)

REAR OF MACHINE →

## SENSOR BOARD, x2 CABLE, PIN IDENTIFICATION

| DEVICE | x2 PIN # | x2 LOCATION |
|---|---|---|
| NTC-3 | 12 | Top row, 6 pins from rear |
| NTC-2 | 13 | Bottom row, 7 pins from rear |
| FLOAT | 21 | Bottom row, 7 pins from front |
| CFS TRANSDUCER (1 of 3) | 11 | Bottom row, 6 pins from rear |
| CFS TRANSDUCER (2 of 3) | 14 | Top row, 7 pins from rear |
| CFS TRANSDUCER (3 of 3) | 15 | Bottom row, 8 pins from rear |
| COND CELL | 16 | Top row, 8 pins from rear |
| ACID EOS | 25 | Bottom row, 5 pins from front |
| BICARB EOS | 23 | Bottom row, 6 pins from front |
| AIR SENSOR | 5 | Bottom row, 3 pins from rear |
| BLOOD LEAK DETECTOR TEST | 2 | Top row, first pin from rear |
| BLOOD LEAK DETECTOR SENSOR | 4 | Top row, 2 pins from rear |
| BLOOD LEAK DETECTOR DIMNESS | 3 | Bottom row, 2 pins from rear |
| BLOOD LEAK DETECTOR OUTPUT | 6 | Top row, 3 pins from rear |
| DIALYSATE TRANSDUCER (1 of 3) | 8 | Top row, 4 pins from rear |
| DIALYSATE TRANSDUCER (2 of 3) | 10 | Top row, 5 pins from rear |
| DIALYSATE TRANSDUCER (3 of 3) | 11 | Bottom row, 6 pins from rear |

# SECTION 18 - MANUAL BALANCING CHAMBER VALVE LEAK TESTS

A. These tests should be run if the automated valve leak tests have not indicated a problem but you still suspect a leaking balancing chamber valve.

B. These tests require intensive work inside the distribution board, plugging and unplugging valves and pumps. Be CAREFUL.

NOTE: Reference is to the HYDRAULIC FLOW DIAGRAM

## BC- 1.0.0 TESTING BOTTOM VALVES ('FRESH SIDE' PRESSURIZED)

a) Turn the machine off and clamp the clear input tubing at VALVE 30 (see diagram below).

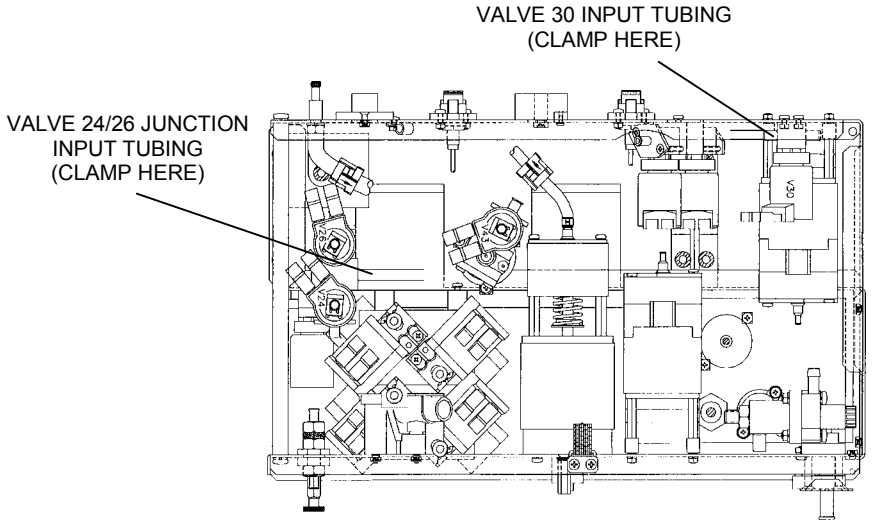
b) Turn the machine on and push the SET button only ONCE. WARNING! Do NOT enter DIALYZE mode.

NOTE: When the VERIFY CONCENTRATE message is up on the screen all top balancing chamber valves are all open while all bottom valves are closed. Also, the deaeration pump runs continuously which pressurizes 'fresh side' valves 35 and 37.

c) From VERIFY CONCENTRATE call up debug screen 9. PDIA should initially read approximately 5 vdc. Monitor it for two minutes. Is PDIA STEADILY decreasing towards 0 vdc? IGNORE UP AND DOWN FLUCTUATIONS.

Yes A leak is indicated at valve 35 or 37. See BC- 1.0.1

No See BC- 2.0.0




## BC- 1.0.1 LOCATING THE LEAK

a) Clamp the clear tubing at balancing chamber valve 32 (see REAR VIEW diagram, page 32) and turn the power off.

b) Turn the power back on and push the SET button only ONCE.

**WARNING!** Do NOT enter DIALYZE mode.

c) From VERIFY CONCENTRATE call up debug screen 9. Is PDIA still decreasing STEADILY? IGNORE UP AND DOWN FLUCTUATIONS.

Yes Valve 37 is leaking

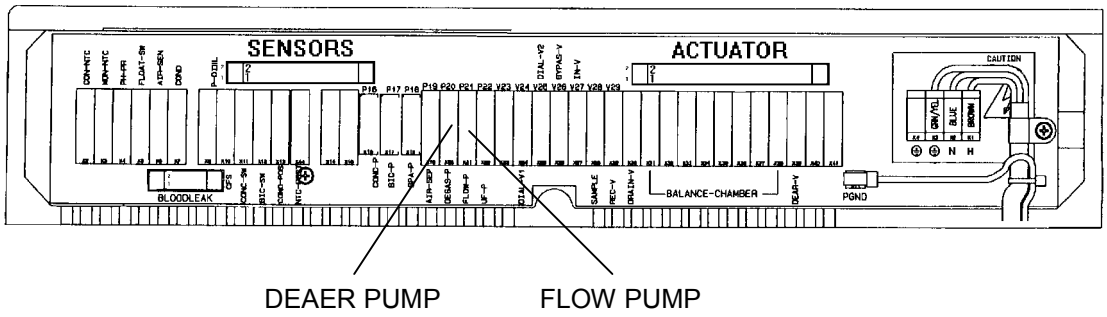
No Valve 35 is leaking.

## BC- 2.0.0 TESTING BOTTOM VALVES ('SPENT SIDE' PRESSURIZED)

a) Remove the clamp from valve 30 and clamp the clear input tubing at the valve 24/26 JUNCTION BLOCK (see diagram, previous page).

b) Turn the heater breaker switch off ("0" pushed down, see diagram A, page 5).

c) Plug the flow pump distribution board connector (P21, FLOW-P) into the deaeration pump's position (P20, DEGAS-P), leaving the deaeration pump unplugged. This makes the flow pump run to pressurize 'spent side' valves 36 and 38.




d) Monitor PDIA for two minutes. Is it STEADILY increasing towards 10 vdc? IGNORE UP AND DOWN FLUCTUATIONS.

Yes A leak is indicated at valve 36 or 38. See BC- 2.0.1

No See BC- 3.0.0

## BC- 2.0.1 LOCATING THE LEAK

a) Clamp the clear tubing at valve 32 (see REAR VIEW diagram, page 32) and turn the power off.

b) Turn the power back on and push the SET button only ONCE. **WARNING!** Do NOT enter DIALYZE mode.

c) From VERIFY CONCENTRATE call up debug screen 9. Is PDIA still increasing STEADILY? IGNORE UP AND DOWN FLUCTUATIONS.

Yes Valve 38 is leaking.

No Valve 36 is leaking.

**BC- 3.0.0 TESTING VALVE 32 ('SPENT SIDE' PRESSURIZED)**

a) Plug valve 36 into 32's position and vica versa.

b) Monitor PDIA for two minutes. Is it STEADILY increasing towards 10 vdc? IGNORE UP AND DOWN FLUCTUATIONS.

Yes Valve 32 is leaking.

No Plug the valves back in correctly and see BC- 3.0.1

**BC- 3.0.1 TESTING VALVE 34 ('SPENT SIDE' PRESSURIZED)**

a) Plug valve 38 into 34's position and vica versa.

b) Monitor PDIA for two minutes. Is it STEADILY increasing towards 10 vdc? IGNORE UP AND DOWN FLUCTUATIONS.

Yes Valve 34 is leaking.

No Plug the valves back in correctly and see BC- 4.0.0

**BC- 4.0.0 TESTING VALVE 31 ('FRESH SIDE' PRESSURIZED)**

a) Remove the clamp from the valve 24/26 junction block and clamp at valve 30 again.

b) Plug the pumps back into their proper positions (P20, DEGAS-P) (P-21, FLOW-P). The deaeration pump now runs to pressurize the 'fresh side' of the balancing chambers.

c) Plug valve 35 into 31's position (V31), and vica versa.

d) Monitor PDIA for two minutes. Is it STEADILY decreasing towards 0 vdc? IGNORE UP AND DOWN FLUCTUATIONS.

Yes Valve 31 is leaking.

No Plug the valves back in correctly and see BC- 4.0.1

**BC- 4.0.1 TESTING VALVE 33 ('FRESH SIDE' PRESSURIZED)**

a) Plug valve 37 into 33's position and vica versa.

b) Monitor PDIA for two minutes. Is it STEADILY decreasing towards 0 vdc? IGNORE UP AND DOWN FLUCTUATIONS.

Yes Valve 33 is leaking

No Plug the valves in correctly. A leak is not indicated using this test.

## SECTION 19 - TESTING FOR A LEAKING BALANCING CHAMBER DIAPHRAGM

This test uses BALANCING CHAMBER VOLUME CALIBRATIONS in an attempt to locate a leaking balancing chamber (BC) diaphragm. There are two parts, collecting volumes from the fresh and spent sides of the diaphragm. For accurate measurements use a dry 100 ml graduated cylinder for each part.

Prior to beginning assure that there are no leaking BC valves using DIAGNOSTICS/VALVE LEAK TEST.

### PART I CHECKING THE FRESH SIDE

a) Loosen the drain hose from the drain port at the back of the machine (don't remove it yet).

b) Place the machine into service mode and enter CALIBRATION/BAL CHAMBER VOLUME.

c) The screen displays: BAL CHAMBER VOLUME
OPTIONAL PRIMING?

d) Push the prime button and allow it to run for 30 seconds.

e) Stop prime and push SET.

The screen displays: BAL CHAMBER VOLUME
PREPARING TO PRIME

Followed by: BAL CHAMBER VOLUME
PRIMING

Followed by: BAL CHAMBER VOLUME
PREPARING TO CALIBRAT

f) You have 25 seconds to remove the drain hose from the port and prepare to collect the fluid output from it with the cylinder. Two cycles will be automatically dispensed. If spillage occurs start over! Collected volume should = the value on the screen. Do NOT change screen values!! Any discrepancy (to the high side) may indicate a leaking BC diaphragm.

Theory: The deaeration pump loads the balancing chamber with fresh dialysate at 19 psi displacing spent to the drain (at 0 mmHg). High pressure on the fresh side of the diaphragm may result in higher volumes to the drain if the BC diaphragm is torn.

### PART II CHECKING THE SPENT SIDE

a) Connect the drain line back to the machine and push RESET to return to the main CALIBRATION menu.

b) Repeat above procedure until the message "PREPARING TO CALIBRAT" appears. You have 25 seconds to remove red and blue hansen connectors from the shunt, put the red hansen into a bucket of water and stand ready to collect the two-cycle output, from blue hansen, into the cylinder. If spillage should occur start over! Collected volume should = the value on the screen. Any discrepancy (to the high side) may indicate a leaking BC diaphragm.

Theory: The flow pump fills the balancing chamber with spent dialysate (at about 12 psi) displacing fresh into the venous dialysate line which is now at 0 mmHg. The higher pressure on the spent side of the diaphragm may result in higher volumes into the venous line if the diaphragm is torn.

**NOTES:**

**NOTES:**

**NOTES:**

# COMMON CONVERSIONS

## PRESSURE

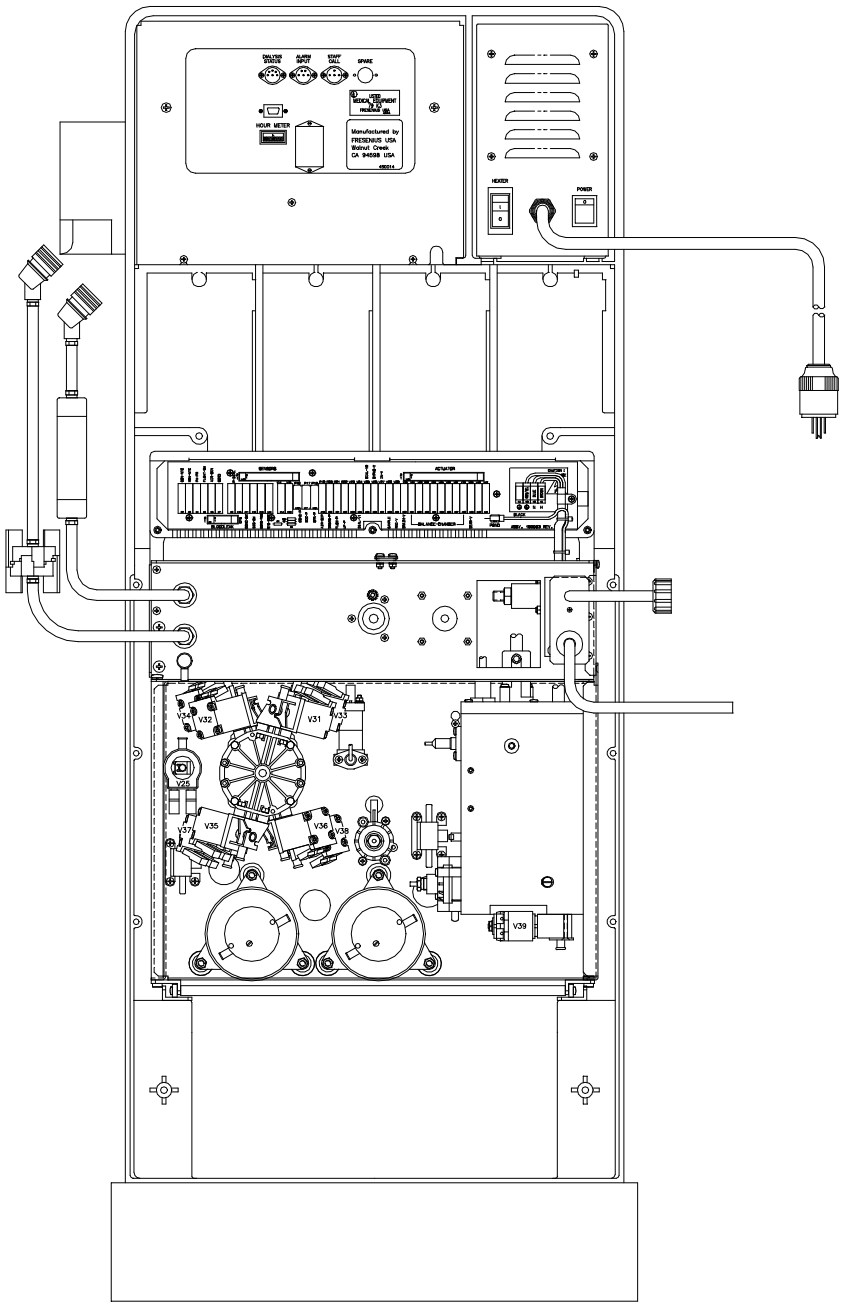
| | |
|---|---|
| 1 Bar | 29.53 inHg |
| 1 inHg | 25.4 mmHg |
| 1 Psi | 51.72 mmHg |

## VOLUME

| | |
|---|---|
| 1 FLUID OUNCE | 26.6 MILLILITERS |
| 1 U.S QUART | 0.946 LITERS |
| 1 U.S. GALLON | 3.8 LITERS |
| 0.034 FLUID OUNCES | 1 MILLILITER |
| 1.057 QUARTS | 1 LITER |
| 0.26 U.S. GALLON | 1 LITER |

## MASS

| | |
|---|---|
| 1 OUNCE (avdp.) | 28.35 GRAMS |
| 1 POUND (avdp.) | 0.45 KILOGRAM |
| 0.035 OUNCE (avdp.) | 1 GRAM |




FRESENIUS USA, INC.
2637 SHADELANDS Drive
Walnut Creek, CA 94598
800 227-2572